THE FOUNDRY

Vol. 43, No. 8 Cleveland, Ohio, August, 1915 *Whole No. 276*

How to Make Automobile Engine Castings

The Practice of an Eastern Foundry Which Employs Molding Machines Exclusively for This Work

FOUNDRIES manufacturing automobile engine castings are continually facing new conditions due to the rapidity with which designs of cars are changed and improved. For this reason a comparison of the present-day practice of a typical automobile motor foundry with the methods in vogue even less than two years ago would show great changes. One of the most important of these changes, from the foundryman's standpoint, has grown out of the demand from automobile engineers for a progressive reduction in the weight of motor parts. This has led to a great increase in the use of aluminum castings, with the result that the aluminum department has grown steadily in importance. A short time ago the manufacturer of automobile engine castings found it unnecessary to provide anything more than a small, one-crucible furnace for his aluminum work; in the well equipped shop of today the aluminum department is fully as important as that devoted to the production of gray iron.

A typical illustration of this is found in the plant of the Lycoming Foundry & Machine Co., Williamsport, Pa., where the facilities for making aluminum castings are on a par with the gray iron equipment. The Lycoming company specializes on the manufacture of high grade automobile engines for modern, light cars. A complete plant including foundry, pattern shop, machine shop, etc., is operated. The gray iron foundry building is an L-shaped structure, 70 x 125 feet on one side and 70 x 90 feet on the other. The melting equipment includes two cupolas, 36 and 54 inches in diameter respectively, the shop having a capacity of approximately 10 tons daily. The aluminum foundry is 60 feet wide and 75 feet long. It is equipped with four natural gas furnaces designed for 150-pound aluminum pots. Special attention has been given to the lighting in this shop in order to have plenty of natural illumination for fine molding work. The management believes that the day wage is preferable in foundries where a uniformly high quality of product is desired, and the molders accordingly are paid a flat rate varying from 15 to 30 cents per hour, depending upon their experience and ability. Considerable success has been achieved with an unusually large proportion of apprentices; this may be partially due to the fact that practically all of the foundry employes are native born Americans.

The crank cases, oil pans, flywheel covers and other important parts of the engines made by the Lycoming company are aluminum. It is be-

FIG. 1—ROLL-OVER MACHINES ARE USED TO MOLD FLYWHEEL CASES

FIG. 2—EQUIPMENT FOR MOLDING ALUMINUM OIL PANS

lieved that success in aluminum founding depends, to a very large extent, on the melting practice, and special attention is given to this feature of the work. The metal is melted in comparatively small quantities, 150 pounds at a time, in order to thoroughly control the quality. Crucible type melting furnaces fired with natural gas are employed. These furnaces, as indicated in Fig. 6, are simple in construction. Each furnace is about 4 feet in diameter and 2 feet in height above the floor, the fire brick lining being held in place by a steel jacket. A cast iron cover plate is used and the metal is melted in cast iron pots. The gas and air enter through a burner of standard construction, which is so adjusted that the flame whirls around the pot in the furnace. Exhaust hoods are provided over each furnace to carry away the fumes, as shown in the illustration. The floor around the furnaces is paved with brick. The heats come up to the proper temperature rapidly and the pots are handled with tongs.

In order to insure a uniform product, the company mixes its own temper-bars in the proportions of 50 per cent aluminum to 50 per cent copper. The temper-bar is melted in a standard crucible type, coke-burning brass furnace. The copper is melted down first, after which the aluminum is added, care being exercised to prevent oxidation.

Mixture Used

A mixture containing 8 per cent copper and 92 per cent aluminum is employed for practically all of the work. In order to save time for the melter and to avoid errors, the proportions of temper-bar and raw aluminum for heats of various sizes are made up in the form of a table or heat card. This heat card is as follows:

Pounds of metal in mixture.	Pounds of temper bar.	Pounds of raw aluminum.
150	24	126
125	20	105
100	16	84
75	12	63
50	8	42
25	4	21

Usually, in preparing for a 150-pound heat, the 125-pound mixture shown in the table is made up and 25 pounds of sprues, gates, etc., are added. Every effort is made to keep the amount of iron and silicon in the aluminum mixture at the lowest possible point. The iron, it is said, does not average over 0.25 per cent and the silicon averages 0.20 per cent. It is believed that the practice of mixing the temper-bar in the shop tends to prevent the silicon and iron from rising to abnormally high points. The expense of this procedure, therefore, is justified through the saving made in molding cost as the result of the elimination of chills from intricate crank case jobs, etc., where they probably would be necessary if the mixtures were high in iron or silicon.

Molding Flywheel Cases

Fig. 1 shows the equipment used for molding aluminum flywheel cases which weigh about six pounds each. Cast iron flasks are employed, together with roll-over molding machines furnished by the Tabor Mfg. Co., Philadelphia. The dry sand core which forms the interior of the castings is made integral with the cover slab, *C*, Fig 1, and therefore no cope is necessary. The flask is 13 inches wide, 21 inches long and 10 inches deep. The mold is gated at one end, no riser being used. The metal thickness is approximately ⅛-inch and to insure the centering of the core, it is backed against a vertical, ¼-inch cast iron plate which forms one end of the mold. The cores are heavily rodded and are handled by eyes which are countersunk below the surface of the slab.

The oil pan for a 4-cylinder, 25-horsepower motor, which is made on the Tabor machine shown in Fig. 2, is also interesting. The casting weighs about 15 pounds, the metal thickness being 3/16-inch. Two machines and three men are employed. The men do all of their own work, including setting cores, shaking out molds, pouring metal, cutting over sand, etc. The drags are molded on one machine and the copes on the other. The flasks are 19 inches wide and 30 inches long, the drag being 3 inches and the cope 11 inches in depth. No riser is employed and the metal is poured

FIG. 3—A FLOOR OF CRANK CASE MOLDS

through a single drop gate, 1 inch in diameter, located in the middle of the flask. A part of the core, as indicated by the pattern on the machine at the left in Fig. 2, is made in green sand, the remainder being dry sand in order to accurately locate the print. The roll-over machines, shown in Figs. 1 and 2, are operated by compressed air at 80 pounds pressure.

The equipment employed for molding 4-cylinder aluminum crank cases is shown in Fig. 3. A turn-over draw machine furnished by the International Molding Machine Co., Chicago, is employed, together with steel flasks manufactured by the Sterling Wheelbarrow Co., Milwaukee. The cope is flat and, therefore, only one machine is necessary. The machine handles the drag, and the cope is hand-rammed on a follow-board set up on horses, as shown in the background in Fig. 3. The flask is 19 inches wide and 37 inches long, the drag being 10 inches and the cope 4 inches in depth. Two drop gates are employed, one being located at each end of the casting.

Equipment for Cylinder Molding

The equipment for molding cylinders which are cast in gray iron is shown in Fig. 7. Although the cylinder is of rather a complicated design, a two-part flask is utilized. In order to obviate the employment of a three-part flask, the pattern is split so that it draws in both directions from the cope and the top of the mold is stopped-off with a dry sand cover core. Contrary to the customary practice, the molds are skin-dried with a natural gas torch instead of being oven dried. The flasks are cast iron, 17 inches wide and 24 inches long, the drag being 3¾ inches and the cope 9 inches in depth. The engine has a removable cylinder head, which is cast separately. A Tabor hand roll-over machine is used for molding the drags and the cope is handled on an Osborn vibrator stand. The two parts of the pattern are drawn from the cope by hand. As the molds are made, the copes are set on special light cast iron stands alongside the drags, as shown in Fig. 7. By the use of these stands, easy access is obtained to both sides of the cope for patching, skin-drying, etc. The barrel and jacket cores are assembled on the drag and when they are in place the cope is set in position. Metal-faced wood patterns are employed.

The iron is proportioned from a mixture of Lake Superior charcoal and northern coke pig iron, together with foundry scrap. The silicon runs about 2 per cent; phosphorus and manganese range from 0.40 to 0.45 per cent, the sulphur averages 0.1 per cent and the total carbon runs about 3.5 per cent.

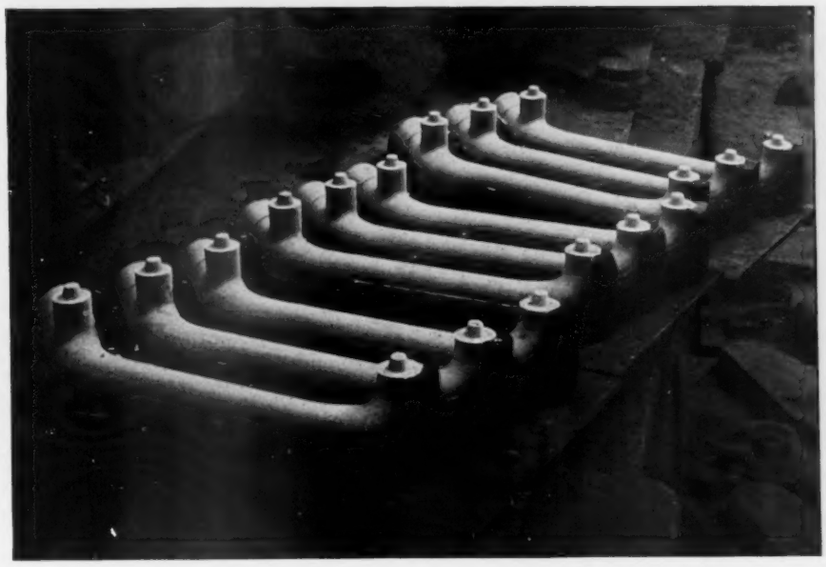


FIG. 5—MANIFOLD CORES IN DRY SAND DRYERS

The pistons are molded with dry sand cores and it is claimed that the method is economical inasmuch as the cores cost only about 1 cent each. The work is done at the bench, there being four pistons in a flask. A special cast iron jig is used to receive the cores and to insure accuracy in centering.

No chills are employed and the pistons are poured from the same gray iron mixture as that used for cylinders, the details of which are given in the previous paragraph.

Dry Sand Core Dryers

The core work in connection with automobile engine castings always presents interesting features. The Lycoming company uses dry sand core dryers and has found them economical and satisfactory. It is believed that they are cheaper than the cast iron core dryers employed in many foundries. The dryers are made in core boxes and last about three months, turning out from 75 to 100 cores each. A strong mixture, 30 parts sand to one part oil, is employed for the dryers and just before they go into the oven they are sprayed with oil which, with the sand, forms a very hard skin. A set of dry sand dryers for manifold cores is shown in Fig. 5.

The cores are made with a pure oil sand mixture, from 40 to 45 parts sand to one part linseed oil being employed for cylinder cores and other gray iron work. The aluminum cores are made from a mixture of one-half sharp sand and one-half molding sand, with an oil ratio of 1:40. The alumi-

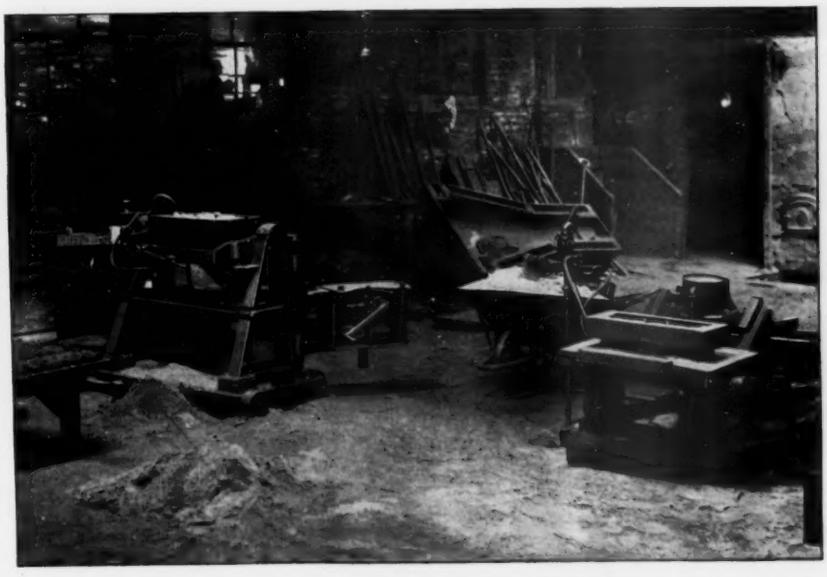


FIG. 4—TWO TYPES OF ROLL-OVER MACHINES USED FOR CORE MOLDING

FIG. 6—A CORNER IN THE ALUMINUM MELTING DEPARTMENT

num cores, of course, must be considerably softer than the gray iron cores. The shop is provided with a four-section, five-drawer, shelf type, coke-fired oven, together with two chamber ovens, each 10 feet wide, 12 feet long and 8 feet high. The latter are provided with shelves around the walls, the heavy cores being placed on iron supports in the center. Like the drawer ovens, they are coke-fired. A Blystone core sand mixer is employed.

Core-Making Machines

Molding machines are extensively employed for making cores. Fig. 4 shows a portion of this equipment. The Adams roll-over jolt machine shown at the right is used for molding jacket and other cylinder cores for both four and six-cylinder engines. Metal faced, wooden core boxes are employed. The portable, Osborn roll-over drop machine, shown at the left in Fig. 4, is utilized for molding cylinder heads, jacket cores, and for other work of a similar character.

The cylinder castings are sand-blasted, the cores being removed on the molding floor before the castings are delivered to the cleaning department. The smaller gray iron castings are tumbled and suitable cleaning room equipment is provided for this portion of the work.

The aluminum castings are cleaned and trimmed in a separate room; it is 40 x 50 feet in size and is equipped with grinding stands, pneumatic chipping hammers and band saws. The latter are used extensively for sawing off gates, fins, etc.

The gray iron and aluminum foundries of the Lycoming Foundry & Machine Co. are operated under the supervision of J. H. McCormick, general manager, assisted by E. S. Cohen, general superintendent.

Strong Cast Iron

By W. J. Keep

Question:—The air furnace castings which we are making now analyze as follows: Silicon, 2.30 per cent; sulphur, 0.06 per cent; phosphorus, 0.50 per cent and manganese 0.70 per cent. Test bars, 1 inch square on 12-inch centers, break at an average of 2,498 pounds. How can we increase the strength of this mixture approximately 30 per cent? What analysis do you suggest and would vanadium give us the desired results?

Answer:—The analysis of your iron is absolutely right, being the same as that recommended by the American Foundrymen's Association for castings of this type. The strength, however, should be 3,200 pounds, but I do not believe that doctoring the mixture will help. The trouble probably can be traced to the physical properties of some of your irons. One foundry company in the central west made very strong iron by exercising great care in the selection of pig iron, particularly with reference to its physical properties.

The analysis of this company's mixture follows: Silicon, 1.50 per cent; sulphur, 0.085 per cent; phosphorus, 0.24 per cent and manganese, 0.37 per cent. The strength of a 1-inch bar was 3,900 pounds.

This suggests that it might be advisable to reduce the silicon by adding steel scrap until your iron is as hard as you can use it satisfactorily in the machine shop. This also will bring your analysis nearer the one just cited. In making the mixture we suggest that you use pig irons of chemical composition as nearly like the final product as possible. Occasionally, when especially strong iron is required, old files and scrap cold chisels are put into the ladle. Be careful about the chemical composition, but also do not overlook the physical properties of everything that you put into the mixture. The strength that you ask for is 3,247 pounds, or exactly what it should be without special care.

A novel feature designed to arouse interest in the annual convention of the American Foundrymen's Association at Atlantic City, Sept. 25-Oct. 1, has been issued by the Foundry & Machine Exhibition Co. An attractive calendar of the last six months of 1915 has been distributed, one of the illustrations on which shows Young's million dollar pier, where the exhibit will be held.

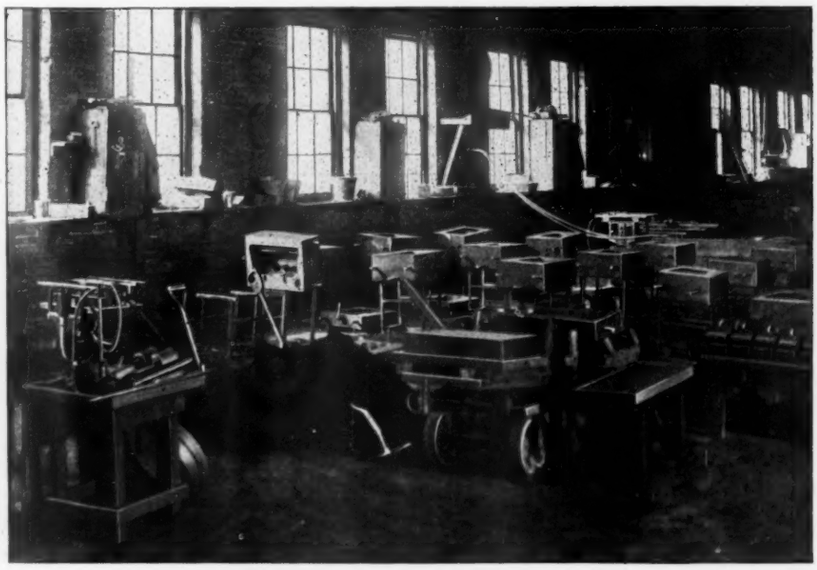


FIG. 7—A FLOOR OF CYLINDER MOLDS

New York State Rules Governing Casting Plants

Regulations Adopted by One Great Commonwealth to Control Foundry Operations and Similar Laws May Be Enacted in Your State

RULES relating to the equipment, maintenance and sanitation of foundries and the employment of women in core rooms, adopted by the industrial board of the state of New York and which are now in effect, are of great interest to foundrymen generally, owing to the agitation in other states for the formulation of similar codes. In both Ohio and Pennsylvania, rules have been prepared and it is probable that they will be adopted in the near future. A wide range of subjects are covered by the New York State rules including drafts, ventilation, sanitation, safety, women coremakers, construction and installation, first aid and general comfort.

In the following, the law is printed in italics, the rules appearing immediately thereafter:

Definitions

Rule 550.—An iron or steel foundry shall mean a place where iron or steel or both metals are melted and poured into sand molds in the making of castings, together with all cleaning, coremaking, drying, wash rooms and toilet rooms, used in connection therewith.

Rule 551.—The term "entrance", as used in these rules, shall mean main doorways opening directly to the outer air.

The term "gangway", as used in these rules, shall mean well-defined passageways dividing the working floor of foundries, but not the spaces between molds. Spaces between molds shall be divided into three classes, which shall be known as "bull-ladle aisles", "hand-ladle aisles" and "buggy-ladle aisles".

Rule 552.—Unless otherwise specified these rules shall, as to the subjects covered therein, exempt foundries from the provisions of rules relating to such subjects.

Entrance and Windows

All entrances to foundries shall be so constructed and maintained as to minimize drafts, and all windows therein shall be maintained in proper condition and repair.

Rule 553.—Entrances to foundries shall be protected from Nov. 1 to April 1 of each year by a covered vestibule, either stationary or movable, which shall be so constructed as to eliminate drafts and of such dimensions as to answer ordinary purposes, such as the passage of wheel-barrows, trucks and small industrial cars. This rule shall not apply to entrances used for railroad or industrial cars handled by locomotives or motors, or for traveling cranes, horse-drawn vehicles or automobiles; these entrances may remain open only for such time as is necessary for the ingress and egress of such cars, trucks and cranes, horse-drawn vehicles or automobiles.

No locomotive shall be permitted to remain inside the foundry during the loading or unloading of the cars.

Gangways

All gangways in foundries shall be constructed and maintained of sufficient width to make the use thereof by employes reasonably safe; during the progress of casting such gangways shall not be obstructed in any manner.

Rule 554.—Main gangways where iron is carried by hand, bull or truck ladles shall be not less than 5 feet wide. Truck-ladle gangways which are not main gangways shall be not less than 4 feet wide. Bull-ladle aisles between floors shall be not less than 3 feet wide. Single hand-ladle or buggy-ladle aisles between floors shall be not less than 18 inches wide. Where trolleys are used over molding floors for pouring metal, the aisles shall be of suffcient width to permit the safe ingress and egress of employes and the safe use of the ladles. Where it is necessary to occupy the central portion of the floor space in the production of molds, continuous gangway space shall be provided.

Rule 555.—During the progress of casting every gangway or aisle shall be kept entirely free from pools of water or obstructions of any nature. Every gangway shall be kept in good condition at all times. Every gangway where industrial tracks are used shall be constructed of a hard material of substantial character and the top of the rail shall be flush with the floor.

Removal of Smoke, Steam, Gases and Dust

Smoke, steam and gases generated in foundries shall be effectively removed therefrom, in accordance with such rules and regulations as may be adopted with reference thereto by the industrial board, and whenever required by the regulations of such board, exhaust fans of sufficient capacity and power, properly equipped with ducts and hoods, shall be provided and operated to remove such smoke, steam and gases. The milling and cleaning of castings, and milling of cupola cinders shall be done under such conditions to be prescribed by the rules and regulations of the industrial board as will adequately protect the persons employed in foundries from the dust arising during the process.

Rule 556.—Where smoke, steam, gases or dust arising from any of the operations of the foundry are dangerous to health and where a natural circulation of air does not carry off such smoke, steam, gases or dust, there shall be installed and operated hoods, ventilators, fans or other mechanical means of ventilation approved by the Commissioner of Labor.

Rule 557.—Where fumes, gases and smoke are emitted from drying ovens in such quantities as to be detrimental to the health or comfort of employes, hoods and pipes or exhaust fans or other mechanical means shall be provided over the doors of such ovens; hoods and pipes will not be required where they would interfere with the operation of traveling cranes, but other effective means shall be provided for the removal of such smoke, gases and fumes.

Rule 558.—The cleaning and chipping of castings shall be done in cleaning rooms except that where traveling cranes or where, in existing installations cars are used for conveying castings into such rooms, a separating partition shall be erected which shall be not less than 12 feet in height. In existing installations, where the crane cage or crane girders will not permit the erection of a 12-foot partition, the height of the partition may be reduced sufficiently to permit of the clearance of same. Large castings may be chipped or cleaned by hand in the molding and casting room provided sufficient protection is furnished by the use of a curtain or screen or some other means equally good to protect employes who are otherwise employed therein.

This rule shall not apply if mechanical contrivances are used for cleaning castings and the dust and particles arising therefrom are effectively removed at the point of origin by means of an exhaust system.

Rule 559.—Where tumbling mills are used, exhaust systems shall be installed to effectively carry off the dust arising from the cleaning of castings, except where the mill is operated outside the foundry. This rule shall not prohibit the use of a water barrel to clean castings. Sand blast operations shall be carried on in the open air or in a separate room used solely for such purpose. The milling of cupola cinders, when done inside the foundry, shall be carried on by an exhaust mill or water mill, each of a type approved by the Commissioner of Labor.

Rule 560.—The floor beneath and immediately surrounding the cupola shall slope and drain away from the base of same.

Rule 561.—No cores shall be blown out of castings by compressed air unless such work is done outside the foundry or in a special room or dustproof enclosure approved by the Commissioner of Labor. Men employed in cleaning castings by compressed air or sand blast shall wear eye guards and helmets.

Lighting and Heating

All foundries shall be properly and thoroughly lighted during working hours.

Rule 562.—Where natural light is insufficient properly to light the foundry, artificial light of sufficient power shall be provided, in the discretion of the Commissioner of Labor.

Rule 563.—Interior walls of foundries shall be whitened, in the discretion of the Commissioner of Labor.

Rule 564.—Proper and sufficient heat shall be provided and maintained in every foundry. Open fire may be used for the drying of molds or cores if coke containing less than 1 per cent of sulphur is used; also charcoal, gas or oils may be so used; where practicable, such drying of molds or cores shall be done at night.

Rule 565.—All hand and bull-ladles shall be dried in ovens or outside of the foundry. A sufficient number of sheet iron shields shall be available in iron foundries for use in covering hand and bull-ladles.

In all foundries suitable provisions shall be made and maintained for drying the working clothes of persons employed therein.

Rule 566.—Suitable facilities shall be provided for the thorough drying of employes' clothing. Such facilities may be located in the washroom, the locker room, or in a room used exclusively for such purpose.

Sanitary Conveniences in Foundries

In every foundry in which 10 or more persons are employed or engaged at labor, there shall be provided and maintained for the use of employes therein suitable and convenient washroom of sufficient capacity adequately equipped with hot and cold water service; such washrooms shall be kept clean and sanitary and shall be properly heated during cold weather. In every such foundry lockers shall be provided for the safe keeping of employes' clothing. In every foundry in which more than 10 persons are employed or engaged at labor where water closets or privy accommodations are permitted by the Commissioner of Labor to remain outside of the factory, the passageway leading from the foundry to the said water closet or privy accommodations shall be so constructed that the employes in passing thereto or therefrom shall not be exposed to outdoor atmosphere and such water closets or privy accommodations shall be properly heated during cold weather.

Rule 567.—Water closets shall be provided in every foundry and for each sex, according to the following table:

Number of persons.	Number of closets.	Ratio.
1 to 10	1	(1 for 10)
11 to 25	2	(1 for 12½)
26 to 50	3	(1 for 16⅔)
51 to 80	4	(1 for 20)
81 to 125	5	(1 for 25)

For every unit of 45 or fractional part

thereof in excess of 125 persons employed, one additional water closet shall be provided.

Rule 568.—Where more than 10 and less than 30 males are employed at one time there shall be provided one individual urinal; where more than 30 and less than 80 males are employed, two urinals shall be provided, and thereafter one individual urinal shall be provided for every 80 men employed or fractional part thereof. At least two linear feet of trough or slab urinal shall be considered the equivalent of one individual urinal.

Rule 569.—Wash basins with faucets for hot and cold water shall be supplied according to the following table:

Number of persons.	Number of wash basins.	Ratio.
1 to 8.....	1	(1 for 8)
9 to 16.....	2	(1 for 8)
17 to 30.....	3	(1 for 10)
31 to 45.....	4	(1 for 11¼)
46 to 65.....	5	(1 for 13)

For each additional 25 employes at least one additional wash basin shall be supplied. Twenty inches of sink shall be considered the equivalent of one wash basin.

Rule 570.—Washrooms hereafter installed where 20 or more men are employed shall be provided with at least one shower bath with an ample supply of hot and cold water, and for every additional 100 men one additional shower bath shall be provided.

Rule 571.—Individual lockers, arranged for locking, shall be provided for employes and shall be placed in a room used exclusively for such purpose, in the washroom, the drying room, or at convenient places in the molding room. In cases of dispute the necessity for and the number of such lockers shall be determined by the Commissioner of Labor.

Rule 572.—The general provisions of the Industrial Code shall apply in all matters not specifically covered in Rules 563 and 567 to 570 inclusive.

Maintenance

The flasks, molding machines, ladles, cranes and apparatus for transporting molten metal in foundries shall be maintained in proper condition and repair, and any such tools or implements that are defective shall not be used until properly repaired. There shall be in every foundry, available for immediate use, an ample supply of lime water, olive oil, vaseline, bandages and absorbent cotton, to meet the needs of workmen in case of burns or other accidents; but any other equally efficacious remedy for burns may be substituted for those herein prescribed.

Rule 573.—Ladles, shanks, tongs, slings and yokes used in the pouring of molten metals shall, prior to their use, be inspected daily as to their safety, by the men preparing and using same, and in addition a regular inspection as to their safety shall be made once a month by a man designated for that purpose. A monthly inspection shall also be made of the chains and cables on counterweights used in connection with drying ovens. Reports of such inspections shall be made on forms prescribed by the Commissioner of Labor, and shall be kept on file for his examination.

Rule 574.—All fire ways connected with drying ovens, when built in the floor, shall at all times be protected by either a substantial protecting cover or a standard rail as defined in rules relating to dangerous machinery.

Rule 575.—All trap doors shall be guarded when open, either by standard rails as described in Rule 574 or watchmen, and all pits shall be properly covered or railed when not in use, and sufficiently guarded at other times.

Rule 576.—All passageways and stairways shall be properly lighted, and inclined runways and stairways, charging decks and platforms shall be safeguarded with standard rails as described in Rule 574.

Rule 577.—All pouring ladles of 2,000 pounds capacity or more shall be equipped with a geared device for tilting same. All pouring ladles shall be so constructed that the center of gravity shall be below the bail, and shall be equipped with a clip to prevent overturning.

Rule 578.—Trunnions on flasks shall be capable of sustaining the loads they are required to handle. Trunnions hereafter constructed shall be carefully designed to carry the load they are to handle and constructed with a factor of safety of at least 10, including bolts where they are used. The diameter of the button shall be equal to the diameter of the groove plus one and one-half times the diameter of the sling used to handle the flask. The side corners shall be well filletted and in order to prevent the sling slipping off or riding the button, the radius of the corner between groove and button shall be approximately equal to the radius of the sling used, the remainder of the inside edge of the button to be straight. All trunnions constructed after April 15, 1915, shall bear the date of their construction.

Rule 579.—The use of high explosives on the foundry premises for the breaking of castings is prohibited unless effective protection is provided.

Rule 580.—The breaking of castings by the use of a drop inside the foundry during working hours is prohibited. Where a drop is used for the breaking of castings outside of the foundry a permanent shield of heavy planking or other effective protection shall be provided.

Rule 581.—Every employe shall use safety devices furnished for his protection by the employer, where there is a hazard connected with his employment.

Regulations for Coremaking Rooms in Which Women are Employed

No female shall be employed or permitted to work in any brass, iron or steel foundry, at or in connection with the making of cores where the oven in which the cores are baked is located and is in operation in the same room or space in which the cores are made. The erection of a partition separating the oven from the space where the cores are made shall not be sufficient unless the said partition extends from the floor to the ceiling, and the partition is so constructed and arranged, and any openings therein so protected that the gases and fumes from the core oven will not enter the room or space in which the women are employed.. The industrial board shall have power to adopt rules and regulations regulating the construction, equipment, maintenance and operation of core rooms and the size and weight of cores that may be handled by women, so as to protect the health and safety of women employed in core rooms.

Rule 582.—Where rooms in which core ovens are located adjoin rooms where cores are made by females and where the making of cores and the baking of cores are simultaneous operations, the partition between such rooms shall be constructed of concrete, hollow tile, brick, metal, or wood covered with metal, or other material approved by the Commissioner of Labor, and there shall be in such partition only such openings as are required by the nature of the business.

Rule 583.—All openings in partitions between the core oven room and the room in which females are employed shall be vestibuled with a revolving device or double doors which shall be self-closing, or any other self-closing device equally effective, which shall be approved by the Commissioner of Labor. Such device shall be kept in such condition that gases, fumes and smoke shall be effectually trapped.

Rule 584.—No female shall be allowed to handle cores which have a temperature of more than 110 degrees Fahr.

Rule 585.—No female shall be permitted to make or handle cores when the combined weight of core, core box and plate at which she is working exceeds 25 pounds.

Brass Foundries

Rule 586.—Definitions. A brass foundry shall mean a place where brass, aluminum, copper, tin, zinc, gold, silver or composition metals containing any of the foregoing metals are melted or poured into sand molds in the making of castings, except that foundries where aluminum only is melted shall be covered by rules governing iron and steel foundries.

The term cellar when used in these rules shall mean a room or part of a building which is one-half or more of its height below the level of the curb on the ground adjoining the building (excluding areaways).

The term basement when used in these rules shall mean a room or part of a building which is one-half or more of its height above the level of the curb.

Rule 587.—The rules relative to dust, smoke, gases or fumes, ventilation, sanitation, heat, light, gangways and aisles, safety appliances, washrooms, cleaning rooms, drying and locker accommodations, as specified for iron and steel foundries, shall apply to brass foundries, except that main gangways shall be not less than 4 feet wide and gangways between molds on spill troughs shall be not less than 3 feet wide.

Rule 588.—When the crown plate of an upright melting furnace is elevated above the surrounding floor in excess of 12 inches, the furnace shall be equipped with a platform with a standard rail; such platform shall be constructed of metal or other fireproof material, and shall extend along the front and sides of the furnace, flush with the crown plate and shall be at least 4 feet in width and shall be clear of all obstructions during pouring time. If the platform is elevated above the floor in excess of 12 inches, the lowering from same of crucibles containing molten metal shall be by mechanical means.

Rule 589.—When the combined weight of a crucible, tongs and molten metal exceeds 100 pounds, it shall be removed from the furnace and deposited on the floor by mechanical means.

Rule 590.—When smoke finish is desired on molds made on benches or tubs, smoke boxes which shall effectually trap the smoke shall be used; such boxes to be connected with flues to the outer air.

Rule 591.—When molders work side by side at least 5 feet of space sideways shall be allowed for each man, and a clear space of 3 feet shall be provided back of each man.

Rule 592.—Hoods shall be provided directly above all brass melting furnaces using gas or oil as fuel, which will effectually trap all gases and fumes generated in the melting of the metal; such hoods shall be provided with outlet pipes to lead the gases or fumes to outer air.

Ventilators shall be provided over all other furnaces used for melting brass or composition metal, to effectually remove the gases above the furnaces.

Rule 593.—Brass foundries shall be provided with natural light from at least two sides or from at least one side, and skylights in roof.

Rule 594.—All persons removing pots containing molten metal from furnaces or handling such pots shall be provided with protection for legs and feet.

Rule 595.—Gangway dirt and floor scrapings shall not be riddled in the room where workmen are employed, unless it is so dampened as to prevent dust arising therefrom.

Rule 596.—Stoves used for drying molds, when located in the rooms used by workmen, shall be surrounded by a casing of fireproof material, to the full height of the stove.

Rule 597.—No brass foundry shall hereafter be constructed with a clearance less than 14 feet between the lowest point of the ceiling and the floor, except that where a peak, sawtooth, monitor or arch roof is constructed the side walls may be of a minimum height of 12 feet.

Rule 598.—No foundry shall hereafter be located in a cellar or basement unless the ceiling shall be at least 14 feet in height, measured from the finished floor to the under side of the ceiling; and, if the foundry is located or intended to be located entirely in the front part of the building, unless the ceiling shall be in every part at least 6 feet 6 inches above the curb level of the street in front of the building; or, if the foundry is located or intended to be located entirely in the rear part of the building, or to extend from the front to the rear, unless the ceiling shall be not less than 3 feet above the curb level of the street in front of the building, and the foundry shall open upon a yard or court which shall extend at least 6 inches below its floor level; nor unless proper and adequate provision shall be made for lighting and ventilation.

Rule 599.—In case any foundry that was legally operated in a cellar or basement on Jan. 1, 1915, shall be discontinued or unused for a period of more than four consecutive months, it can thereafter be reopened as a foundry only by complying with the provisions of the rules relating to future foundries. The occasional operation of a foundry for the purpose of evading this rule shall not be deemed a continuance of use thereof.

First Aid Outfit

In the code governing the sanitation of factories and mercantile establishments, the following rules relating to a first aid outfit apply:

Rule 178.—In every factory employing more than 10 persons, in which power-driven machinery is used for manufacturing, there shall be provided a first aid kit at all times free of expense to employes. The commissioner may require such equipment to be furnished in mercantile establishments. A suitable and easily accessible space shall be set aside to administer first aid, which will insure a reasonable amount of privacy both to the injured and the person rendering first aid. There shall be provided therein two chairs, a small table, and washing facilities consisting of

water, basin, towel and soap. If the establishment occupies more than one floor, a stretcher shall be provided. The first aid case shall be made of either metal or glass, shall be so constructed as to exclude dust, and shall be kept clean. In all establishments where work is carried on in more than one building or on several floors, duplicate kits shall be supplied as directed by the commissioner.

Where a separate hospital room is maintained for the use of employes who are injured or sick, the first aid kit may be dispensed with, except that in hazardous occupations a simpler kit should also be kept for immediate use in parts of the building located at a distance from the hospital.

Rule 179.—In every establishment where a first aid kit is to be maintained, at least one person shall be instructed by a physician or trained nurse how to apply first aid to injured persons and shall have charge of the first aid kit and its maintenance. Such kit shall be for first aid use only.

It is recommended that when an employe is so seriously injured that he must stop work for the day, the service of a physician should be secured as promptly as possible.

Rule 180.—The contents of the first aid case shall be as follows:

One pair scissors.
Thumb forceps.
Tourniquet.
Graduated medicine glass.

Drugs

2 ounces aromatic spirits of ammonia.
2 ounces 4 per cent boric acid.
2 ounces alcoholic iodine solution, half strength (for external use).
Two 3 ounce collapsible tubes of bicarbonate of soda mixed with vaseline (3 per cent), (for burns).
2 ounces castor oil (for eye injuries).

Dressings

One dozen assorted sizes sterile gauze bandages.
One spool Z. O. adhesive plaster, 1 inch x 5 yards.
Three ½-ounce packages of absorbent cotton.
Three 1-yard packages of sterile gauze.
Splints of assorted sizes for fractures.
Wooden applicators wound with cotton.
Wooden tongue depressors.

All bottles or other containers containing drugs or other substances shall be clearly labeled and the specific purpose for which the contents are to be used shall be marked thereon. Directions for the use of the first aid kit may be secured from the commissioner.

The industrial board may approve special types of first aid kit and also may designate more elaborate first aid kits for special industries.

Note:—On account of the importance of prompt sterile dressing of all wounds to prevent infection, it is recommended that, wherever possible, employers should secure the services of a physician or trained nurse to visit their establishments at least once a day.

Success and Failure in the Foundry

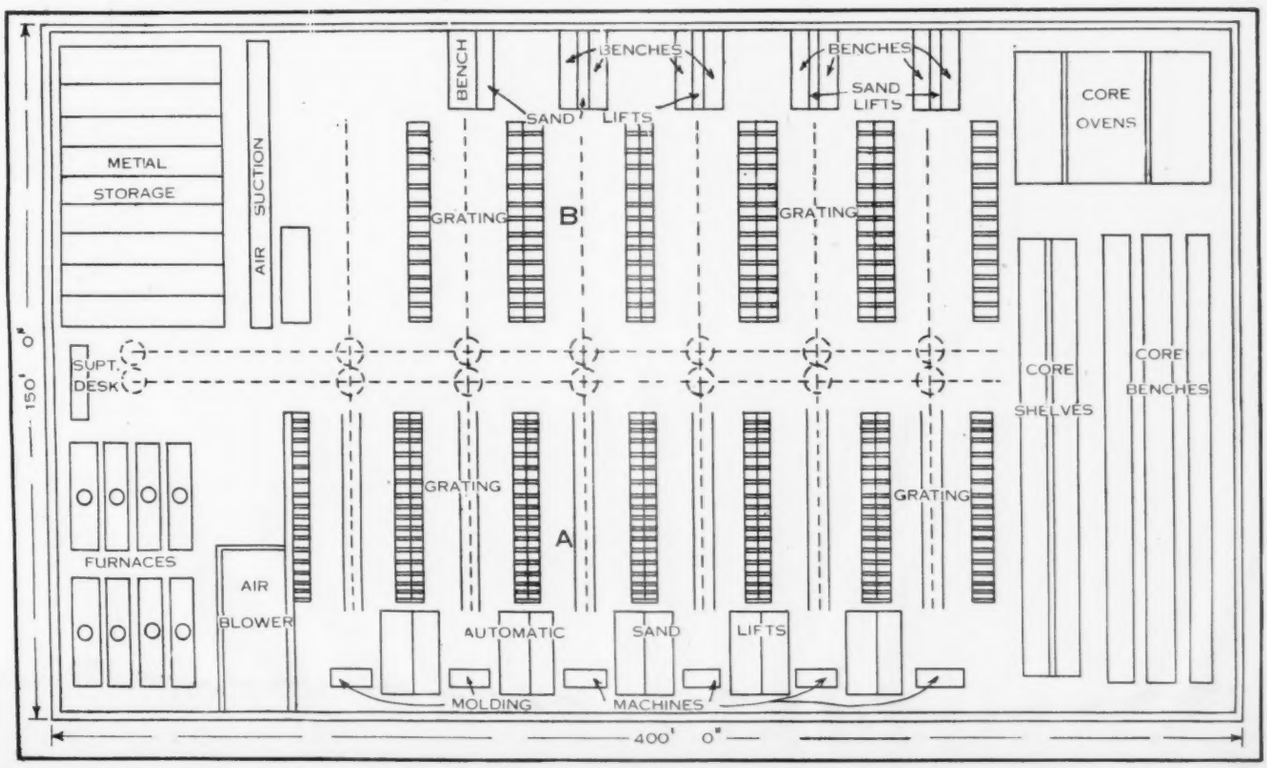
By A. Kiefer

WHAT was wrong with Smith's foundry? Why was it continually losing money? Recently Smith put these questions to himself time and again, but found no answer to them. When the foundry was first erected he realized the importance of having fuel, sand and metal within easy access, and consequently located the plant advantageously as regards raw material receipts and shipping facilities. He had not exercised the same care, however, in the selection of his equipment and his foreman. Such matters as tools, organization, sanitary conditions and other details he had left in the hands of inexperienced subordinates. The result was that almost from the beginning there had been a small output, bad castings and continual discord between the management and the workmen.

Smith Wakes Up

One day Smith woke up. While on a business trip to a neighboring city, he had occasion to visit the plant of the Doit Casting Co., which maintains one of the finest and best equipped foundries of the country. After going through this shop he realized how antiquated and ill-managed was his own. This particular foundry was so arranged that the expenditure of unnecessary labor was practically impossible. It was on the third floor of the main building of the plant and had a floor area of 400 x 150 feet.

As shown in the accompanying plan of this shop, the melting room was situated at the extreme end of the foundry. The transportation of the metal was accomplished by means of ladles swung from an overhead trolley which ran down the main aisle and into the intersecting cross aisles. This facilitated the handling of the metal



PLAN OF THE FOUNDRY WHICH SMITH VISITED

and eliminated the danger of accident. Heats were taken off four times a day, twice in the morning and twice in the afternoon. A separate corps of men were maintained to push these ladles from the metal room to the molding floors and in this way the molder was relieved of the work of carrying his own metal and was allowed to devote all of his time to actual molding. After pouring the metal, the molder shook-out his flasks and the sand dropped through a grating. It was then automatically mixed and delivered to the molding floor to be used for the next heat. The machine molders were stationed on the side of the floor, *A*, and the bench and floor molders were placed on the opposite side, *B*. The core room was situated at the end of the shop opposite the metal room.

The Equipment of the Model Shop

This general description will give the reader a bird's-eye view of the plant. To go further into detail, each bench molder was supplied with a vibrator, an air-hose, a shovel, a riddle and two rammers. This arrangement astonished Smith, who remembered that in his shop the men went into partnership with their tools, and upon making inquiry he found that since this individual system of equipment had been in vogue, there had been less time wasted in looking for lost or hidden tools. Each man having his own set, was held responsible for them. If a workman had occasion to borrow something from his neighbor he saw to it that it was replaced when he had finished using it. In addition to the tools furnished by the company, each man when employed was required to have a complete set of the necessary small tools. If he did not have these they were furnished by the company at cost. A certain amount was deducted from his wages each week until the tools were paid for, and they could be returned, if in good order, when he left the company's employ. No tools of any kind could be obtained without a requisition, duly signed by the timekeeper and presented to the stock clerk. Prior to the adoption of this plan there had been a great deal of material carelessly wasted, but this loss was now eliminated.

In the actual operation of the foundry it was one of its superintendent's axioms that too often the foundry was untidy and uninviting, owing to the fact that no one seemed to concern himself about this phase of the management. It had been found, however, that it was much better policy to have things in order so as to eliminate the chance of accident and to facilitate the rapidity of the work. Another axiom was that the men to be contented must be healthy and satisfied. If the men were to be healthy the shop must be kept sanitary, and everything was done to bring this about. The ventilation of the foundry was so arranged that the greatest possible amount of fresh air was continually passing through. There were windows in abundance so the foundry was both light and airy.

But what impressed Smith the most were the men's locker rooms. This unique arrangement was situated on the first floor of the building. The rooms were large and airy, the floors were cement and were always kept scrupulously clean. The lockers were made of steel and were arranged in rows about six feet apart. A long metal trough stood before each one of these rows, and when the time came for the men to wash-up, these troughs were filled with warm, running water. There were also shower baths for those who wished to use them, and, taken as a whole, the men were made to feel that they were just as worthy of consideration as the office force which had these conveniences as a matter of course.

Piecework

Smith learned that most of the work was done on the piecework basis, and that the rates which were set by the foreman, when once fixed were never cut simply because a workman became more proficient in his work. Smith had at last found out how a plant could be run profitably, and it is to his credit that he went home with both resolutions and plans carefully made for the betterment of conditions in his own foundry.

Cast Vs. Forged Shrapnel Casing

IN VIEW of the large orders for shrapnel that recently have been placed in this country, and which aggregate hundreds of millions of dollars, some investigation has been made by several producers of gray iron and steel castings, of the possibility of meeting the exacting requirements for shrapnel casings with the cast product in place of the rolled and forged steel.

It was reported from Belgium, that what are presumably cast iron shell cases have been picked up on the battlefields in that country, which were undeniably fired from German guns. The cast iron samples examined were fragments from a 6-inch diameter shell, the internal surface of which had been cast against a chill, while the outside had been turned.

It was pointed out to American foundrymen that cast shells would not meet the necessary requirements, although in several plants cast shell casings were made. In target practice, cast iron shells, made in permanent molds have been used by the United States navy, these casings having been made at the League Island navy yard, Philadelphia.

The alleged use of cast iron shells by the Germans aroused considerable interest in England and the observation made and the deductions drawn by *The Engineer, London*, follow:

"There are several objections to cast shells. In the first place, where shrapnel is concerned, the number of bullets is reduced because the walls of the projectile must be made much thicker. In the case of high-explosive shells, this does not apply in so great a degree, because the walls of the steel shell are then made thicker than is necessary for strength, but there is such danger of a cast iron shell developing cracks during manufacture that high explosives cannot safely be used in them. It must be remembered that no risk of a shell bursting in a gun must be run, and no one will doubt that there is more risk in cast iron than there is in forged steel.

"Another point against cast iron is connected with accuracy of fire. To ensure this, the projectile must be perfectly in balance. The walls must not only be of exactly the same thickness all round, but they must be homogeneous. At the very high speed of revolution set up by the rifling, a small difference of weight to one side of the center line would be quite sufficient to cause irregular shooting. With forged steel there is little or no difficulty in securing this balance; with cast iron there is always some danger of local porosity, which, besides being a source of weakness, would destroy accuracy.

"Moreover, if the projectile were cast on a chill core and was not machined internally a risk of the core not being absolutely concentric would always have to be faced. Accurate fire would then be impossible. To remove a chill core, even if it were

collapsible, it would be necessary to have a large hole in the base of a high explosive shell, of which the point is always solid, which subsequently would have to be plugged. If a sand core were used it might be removed through a smaller hole, but the machining of the interior would be difficult owing to the shape of the head and the smallness of the hole through which the tool must be entered. In the case of shrapnel the boring would be much easier, because a large opening is left for filling purposes, but, owing to the small number of bullets that could be carried, cast iron shrapnel cannot be considered.

"All these facts have militated against cast iron shell, and although, of course, cast iron and cast steel were used at one time they have entirely given place to forged steel. Furthermore, the methods of manufacture of steel shell have been so developed that such shell can actually be turned out more quickly than those of cast iron of equal reliability and accuracy. An 18-pounder shell for example, can be completely machined from the bar in about 40 minutes. The case for the forged steel shell is, then, complete, and there is no case at all for the cast iron shell."

Shop Management and What It Means

By E. W. Wallbank

SUCCESSFUL shop management should embody the following principles: originality, tact, organization and system. Originality is a great asset to the executive. A man in charge of a department who is unable to make a decision is always in a turmoil. He cannot decide for himself and if he cannot do this, how is he going to decide for others? It is a greater failing to be indecisive than to decide erroneously at intervals. When the foreman is presented with some difficulty which arises, he should first decide what would be the best method to pursue, then he should listen to the workman's view. After careful analysis of both methods, he extracts the virtues from each and makes a decision. As Emerson said: "Behold when the great God lets loose a thinker on this planet." Thought and originality are so incorporate that you cannot possess one without the other.

I once worked in a shop where cylinders were made. These castings had a neck on one end with a flange which formed a thin body of sand. This thin body of sand was cored-out and the water jacket core was held in position with four nails extending up through the metal. The cylinders were cast on end and had been cast this way for years. The company employed a new foreman for this department, and after losing a few of these castings, he decided to merge the water jacket core and ring core into one, which proved a success. That man was original and a thinker. He did not follow the ancient method, but resorted to self-reliance.

Tact, is that part of management which promotes enthusiasm and friendship between the men. This is manifest in a foreman, who while not arrogant, is firm and impartial. When a man spoils a piece of work he does not administer a severe calling down, but rather presents the facts in such a way as to make the man ashamed of himself, and not antagonistic toward the company and himself. A tactful man will not reproach a workman in this way: "What's the matter with you, don't you know any better than that? I don't see why the company should pay for such incompetent work." After he has reproached the man in this manner, he has built a barrier between himself and that employe which is not easily broken down. A better way to discuss the matter would be something like this: "Say, Jack, don't you think we would get better results if you considered so and so?" The man would then set forth his reason for pursuing his method, or, if he was at fault, would gracefully concede to your suggestion and resume his work with a good will and feeling toward you and the company.

While visiting an up-to-date foundry I noticed a placard pasted upon the door of the foundry office. It read something like this:

Smile with the world, don't frown alone.
Don't knock, it's a fault, not a virtue.
Keep your eye off the clock. The whistle will blow at quitting time.
The other fellow's job will grow rapidly, watch your own.
You are an important factor in the success of this department.
If you have a good idea don't isolate it, the foreman will be pleased to listen to you.

While this placard set forth the disposition of the company, it did not arouse the indignation of the men. The foreman never forgot his men were gentlemen, and never let them forget he was one. As a result, that department had the highest efficiency of any department in that plant. No man can expect the best results from workmen unless he has the good will and friendship of the men in his department. Tact is the ability to approach a delicate matter successfully. A man once said to a tactful man: "What do you think of that job?" He replied: "I think that is the best job you could have made." Tact is resourcefulness. Organization is one of the foremost necessities of intelligent management. A department can have a complete force of first class mechanics, yet the organization may be inferior. Another department may have only a few first class mechanics and a majority of average mechanics, yet the organization can be perfect. To illustrate this I will take two men—*A* and *B*.

A—communicative, friendly, honest and industrious—experience.

B—experience, good workmanship, non-communicative, friendly, honest and industrious.

A will work at all times and give the company his best efforts. When a fellow workman has a job similar to one he has previously made, he will communicate the benefit of his experience, and help to facilitate production.

B will only work when the foreman is watching him. All he knows he keeps to himself. He would rather deter a fellow workman than assist him.

A is an asset to good organization.

B is a detriment to good organization.

I will give another illustration which will leave no doubt as to my opinion on this point.

A shop has received orders for a large casting. The foreman picks out six of the best workmen in his department. They start to argue regarding the best method of procedure. Result: discord, lack of interest, carelessness and ill-feeling. The job is finished with no real interest on the part of any of the men. On the other hand, the foreman picks out two first-class men and four average men. They are friendly with each other and co-operate in their efforts to produce a good, clean casting at a minimum cost. The job is finished with all hands manifesting great interest. It is reasonable to assume that the second gang of men will produce the casting better and cheaper than the first gang, yet they will all maintain a high regard for each other. Organization consists of harmony, communication, honesty and contentment.

System is the last, but not the least of the four principles. We cannot build a flask without system. We must first determine the length, width, depth, number of bars, thickness of flask, thickness of bars, clearance for sand, strength and construction. Taking the pattern department as an example, as it is difficult to establish a set rule for system in that department owing to the variety of work, I would suggest the following as a systematic method of procedure:

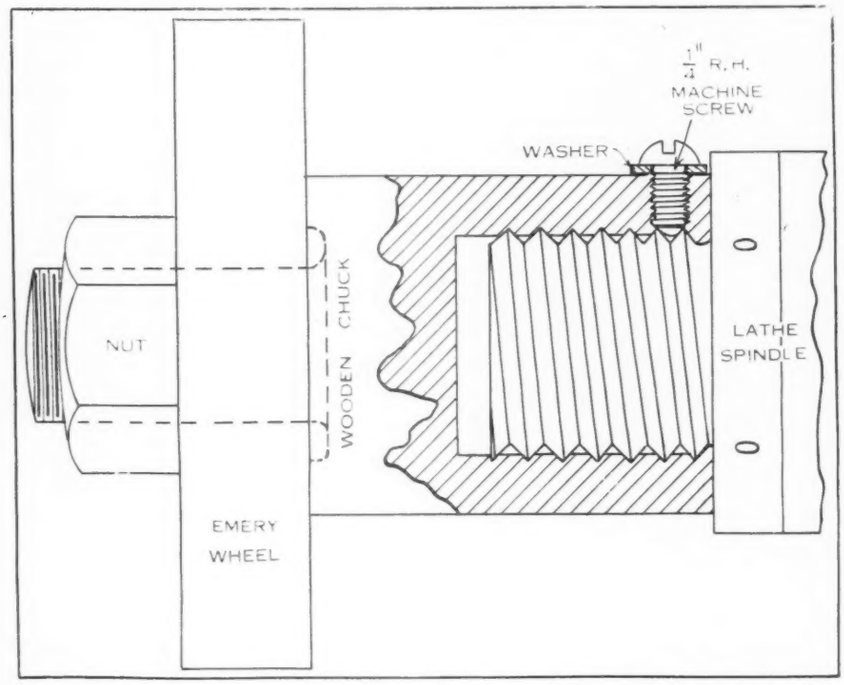
When the drawings are delivered from the drafting room, look them over carefully one at a time. After deciding on how to mold and construct the job, turn the corner up and write the workman's name on it, then you are prepared to give a man a new job at a minute's notice. In the morning sign the time cards and have them submitted to the time clerk. Do not allow the men to check up each others' work. Have a checker or do it yourself. Have the glue pots conveniently arranged and always full of glue. Keep leather fillet and other fillets in a rack where they can be easily reached. Wood dowels should be in the same rack. Each man should have a separate shellac pot. Much time is wasted in hunting shellac. Brass dowels and plates, screws, nails, rapping plates and other pattern accessories should be kept in assorted boxes.

Subsequent to the completion of a pattern, turn it over to the pattern clerk for delivery to the foundry. Much time is lost hunting mislaid patterns. Jot down the date a pattern is completed and the pattern number. Have all lumber located conveniently, so a man won't have to turn up a whole pile of lumber to get a certain board. Attend to any complaints or suggestions from other departments at the time of their birth. Procrastination is the thief of time. Many controversies are avoided this way. There are many other little conveniences that can be adopted in the pattern shop.

Trying to run a shop without system is like trying to run a ship without a rudder. You don't know where you are going in either case. This discussion of system recalls a small plant which was without a set of rules to direct operations. The men worked merely from mental impressions. This company manufactured engines, and I often marveled at the degree of success it maintained with such loose methods. When an order for a duplicate part was received, the superintendent would go to the casting shed, secure the desired casting and proceed to machine it as per instructions via superintendent to foreman, foreman to mechanic. This method frequently proved disastrous, for upon shipping the duplicate part it was returned as being a misfit, too large or too small. However, this loose-handed method soon met with disaster. A few years ago this company employed a man who re-organized the plant and put it on a systematic basis.

No organization can expect to meet with a great degree of success until it has adopted a system that will expeditiously fulfill its particular requirements. If system is a necessity to large things, it goes without saying it is an accessory to small ones.

Thus the four principles set forth build an indestructible foundation for the efficient conduct of any department.



DEVICE FOR MOUNTING PATTERNMAKER'S EMERY WHEEL IN A LATHE

Emery Tool Grinder for Patternmakers

A letter from Con Murphy.

I grind all, or nearly all of my tools on an emery wheel. Some patternmakers think that if you go within a foot of a grinding wheel you spoil or draw the temper of an edged tool. However if you do not keep your tools sharp your work is sure to be spoiled. Also if you don't keep your emery wheel sharp, you will be sure to draw the temper of tools. Some patternmakers, apparently, have never heard of an emery wheel dresser and there is little wonder that they have trouble in grinding tools on wheels that are never put in proper condition.

I carry an emery wheel as a part of my turning tool kit. The wheel is mounted as shown in the accompanying illustration. No special wheel stand or arbor is necessary, the lathe spindle being entirely satisfactory. The wooden chuck which fits over the nose of the spindle is made of maple. It is held in place by a ¼-inch machine screw ground or filed to a V-point so that it will engage the thread on the spindle nose. The outer end of the chuck is turned to fit the hole in the wheel. The jamb nut will cut its own thread. It will not be a full thread, but it will hold sufficiently well.

The secret of successful tool grinding is to keep the emery wheel sharp and properly dressed. It will then do its work without burning the tools. A stick of carbon is entirely suitable for dressing the wheel and it takes up about as much room in your tool kit as a lead pencil.

Steel Casting Concern Expands

The George H. Smith Steel Casting Co., Milwaukee, has purchased the property on which its foundry has been located for the past 17 years, together with buildings and land adjoining. The Smith company plans to erect shortly a new building, 65 x 150 feet, to serve as a shipping room, and permit the main foundry to be used exclusively for molding and casting. This company has been employing the converter process for 16 years, having erected and operated one of the first commercial foundries in the United States. It manufactures low carbon steel castings for electrical purposes, and alloy steels of various kinds including manganese, vanadium, nickel, chrome and special carbon.

Miscellaneous Stands for Use in the Foundry

Ingenious Devices Which Economize Space and Prove Helpful in Maintaining an Orderly Condition in Casting Plants

By Allan Hill

THE absence of stands or racks in the foundry is a feature that does not seem of much importance until one has seen them used, yet it is remarkable what a difference they make in the appearance of the shop.

Not only in the foundry, but in the cleaning room, warehouse, loose and plate pattern storage and in the core shop are stands useful, providing they are of suitable design, strong enough for the purpose required, compact and easy to erect, look neat, and where the position is not permanent, can be moved easily to another position.

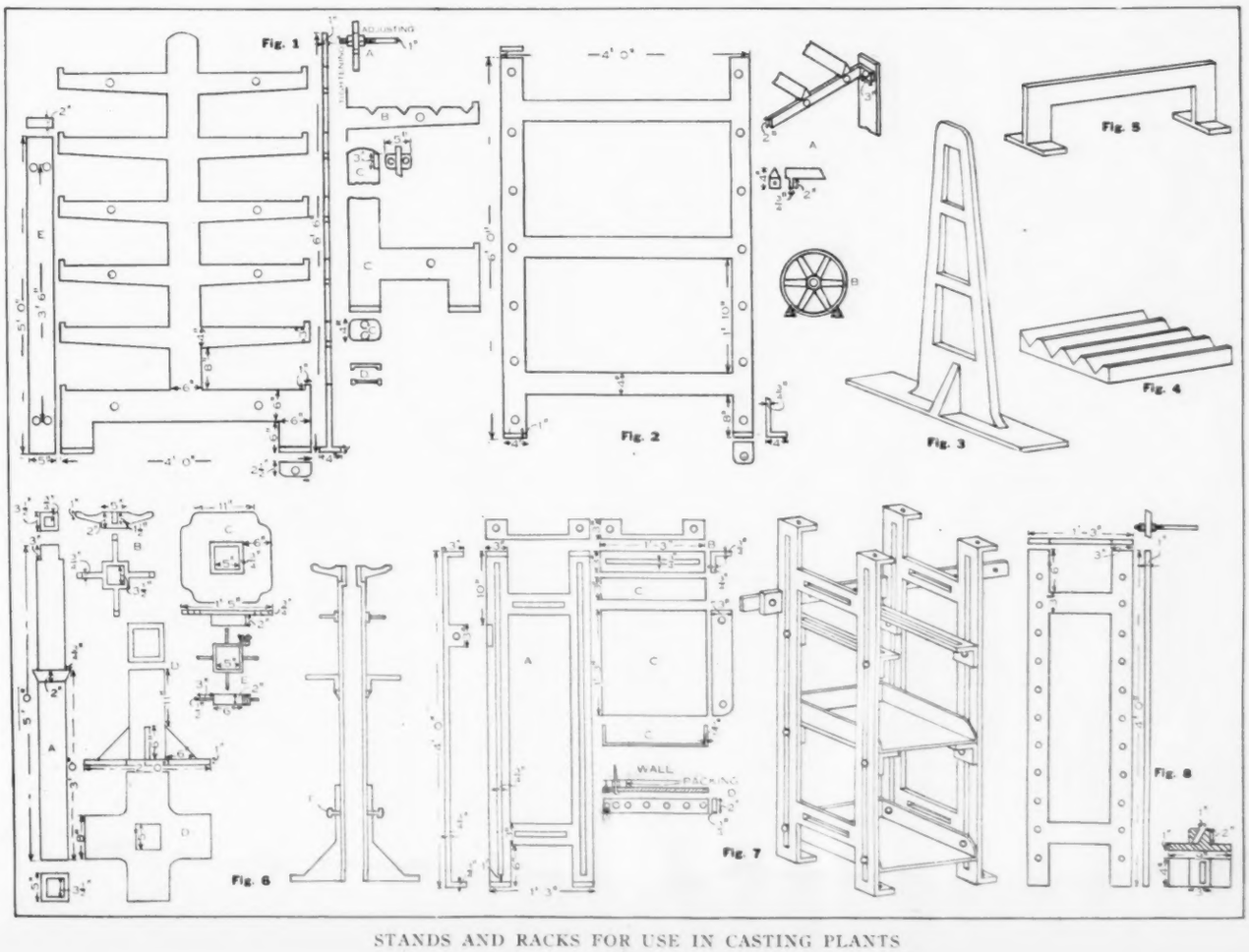
In this article, stands will be described that by actual use have been found to be the most useful for this purpose, and the series will generally cover the different varieties of patterns and castings in most foundries, and by altering some parts may be made to serve for special purposes that are not mentioned. The dimensions given will not be suitable for all purposes. Some stands will need strengthening where heavy articles are used, while some will do if made lighter, but those given are the average used for general service.

Storage Racks

Fig. 1 is a stand that by varying the design can be used for long, narrow articles of any description, such as pipes, columns, rollers, rails, core barrels, loam cores that have been dried and finished, etc. *B* shows how the arms are altered when a large quantity of loam cores of a standard length are being made so that the stands may be used in the core drying stove for the purpose of drying the cores. They also can be fitted with shelves, either wood or iron, and if they are to be attached to a wall, one set of arms can be eliminated and lugs cast on, as shown at *C*.

They are set up by placing the sides a suitable distance apart, and then round, wrought iron bars, threaded at both ends, are used to secure them. The way this is done is shown at *A*, two nuts being used, one to adjust and the other to secure. Eight of these bars, 1 inch in diameter, will be sufficient to make the stand rigid enough for most purposes, but more can be used if necessary.

If the stand is to be attached to a wall, the bars are used, and holdfasts are driven through the lugs into the wall. These stands can be made lighter by one of the two methods



STANDS AND RACKS FOR USE IN CASTING PLANTS

shown at *D*, and where very heavy articles are placed upon them, they are bolted down to cast iron sleepers, but for ordinary purposes they will be firm enough without these.

Fig. 2 is a stand that is also very useful and one that can be altered to serve many purposes. It is generally used for lighter articles than the stand illustrated in Fig. 1 and is erected with the uprights closer to each other. The method of attaching the stand is the same, but the articles are placed across the bars in this case, so more bars will be used. By using rails instead of the bars, the stand can be used for pulleys, wheels, etc., these rails having holes at suitable points to enable shorter rails to be secured to them, as shown at *A*, the method of stacking being shown at *B*. Wheels and pulleys, by using this method, will be found to pack more compactly than by any other method.

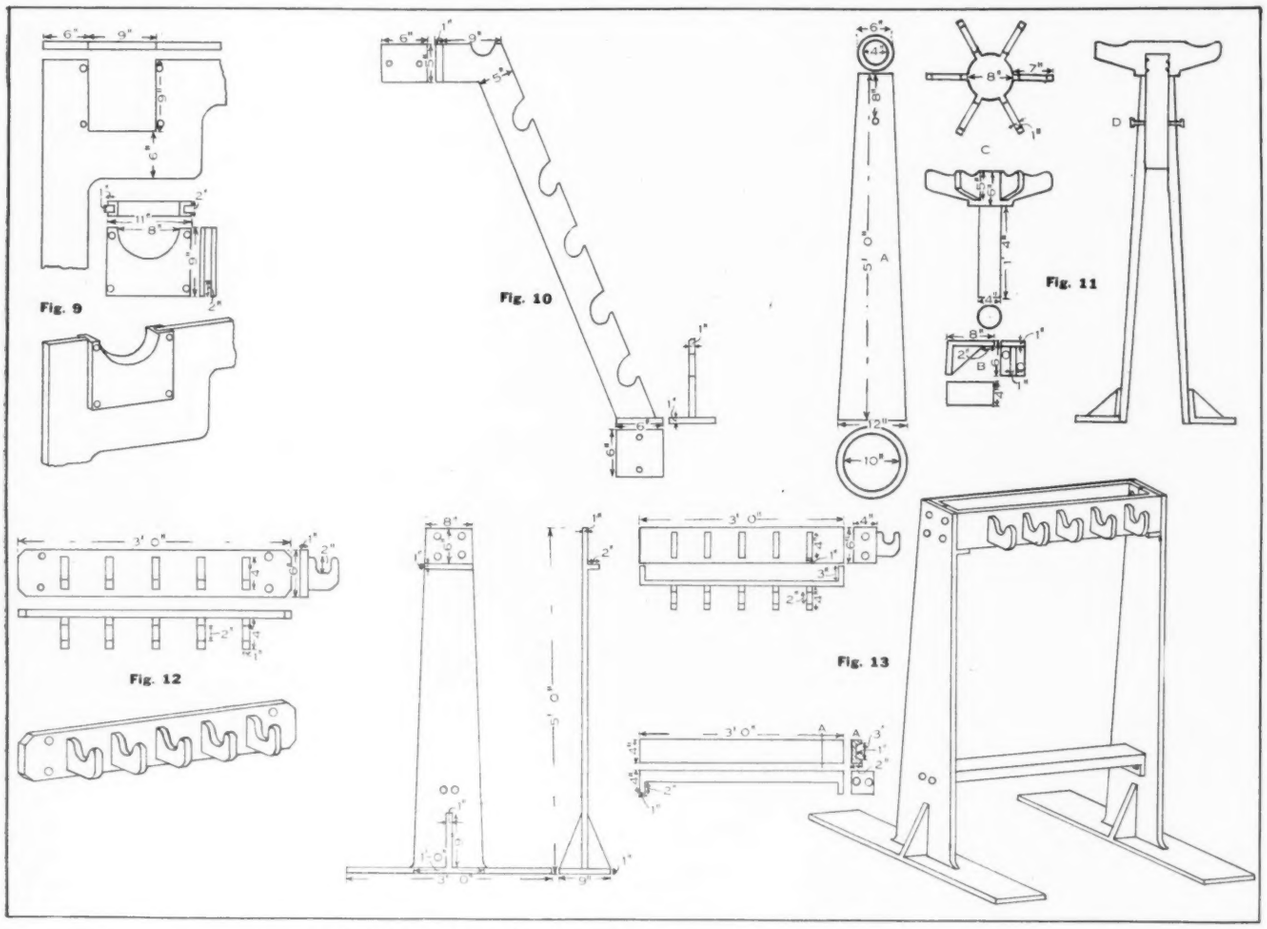
The stand shown in Fig. 3 is used to rear copes of hinged flasks against. It is buried in the sand for about 1 foot, so that the copes can be placed without displacing them, and can be used for two copes at the same time. Fig. 4 is a cast iron block with a saw tooth section. It is used when the castings or patterns are reared against a wall, so that there will be no danger of their falling.

Fig. 5 is an ordinary trestle. One pair with boards placed to form a platform will be found useful for irregular shaped patterns, such as pipe elbows, cylinders, pumps, etc.

Fig. 6 shows a stand that is used by the molders. It is made up of five parts, an upright square pillar, *A*, fixed in a socket, *D*, a shelf with grooves cast in the sides, *C*, a wrought iron collar with studs, *E*, and a top made of cast iron, equipped with four hooks. Against these stands loosening bars, rammers, etc., are placed; riddles, etc., are placed on the top, wood screws, pulley hooks, etc., on the studs, and the shelf is used for brushes, sprigs, tools, cores or any small article used by the molder; *F* shows how the pillar is fixed in a socket by a screw, and *E* shows how the wrought iron collar is tightened, a nut and bolt being used.

Fig. 7 is a stand that is a fixture. It is useful in the core shop, plate pattern storage, small casting warehouse, etc. The parts used consist of uprights, *A*, to which are attached shelves, *B*, or trays, *C*, rails, with holes at suitable distances, being used to erect them. The rails first are attached to a wall, sufficient space being left between the wall and the rail to enable a nut to be placed and tightened so as to secure the upright to the rail, *D*. The shelves are then placed in position, two, one on each side, being secured by the same bolt.

If the stands are not intended to be attached in this manner to a wall, they can be erected on the floor. The same rail is used, but two stands, back to back, are fixed, and if they are to be increased in height, another set can be attached to the top by means of the feet that are cast on the uprights, so there is practically no limit to the height of such stands. If these stands are to be used in the core shop, either shelves with loose trays or trays secured to the uprights may be used, but the loose trays are most serviceable, as they can be filled with cores placed in the core-drying stove in similar trays, which, when the cores are dry, can be carried out and other trays can be put in their place. They also save waste, as the molder can take them to the mold, use the cores he needs, and if any are left, return them to the core



ADDITIONAL STANDS AND RACKS FOR USE IN CASTING PLANTS

shop with the tray, whereas if he takes them away loose, he generally destroys the cores he has left.

Where the stands are intended to be used for storing core boxes or small patterns, the trays are secured to uprights, one advantage of this method being that the stands are more rigid if it is possible to make them so, as they are quite firm when attached by the other method. Both are shown in Fig. 7, as well as the way pattern plates, pulleys and wheel patterns are stacked on two shelves.

The stand shown in Fig. 8 is used in the core drying stove. It is placed against the walls, loose feet being used to give the correct angle and also to prevent them from slipping. Round wrought iron studs are attached, as shown, the thickness depending on the weight to be placed on them. These studs are attached by two nuts, and are placed down the whole length of the upright, holes being cast in for this purpose. These stands are useful for the drying of cores made on machines where they are made on trays.

Fig. 9 is a coremaker's trestle. It has been designed to enable the coremaker to work on the front portion, no matter what size of core he is making, and supersedes those having a number of grooves of different sizes. The working faces of the uprights are cast, as shown in the accompanying illustration, and a series of blocks are used for bearings, these blocks being made to fit in the socket of the upright. One advantage of this method is that if one groove happens to get worn out it can be replaced without casting a fresh upright.

Fig. 10 is a stand that is used to dry and store loam cores, and also for heavy roller patterns, etc. Two uprights are required, one secured to the floor and wall and the other free to enable it to be moved about so as to suit different lengths.

Figs. 12 and 13 are used for hanging chains or any other suitable article upon. Fig. 13 is movable and can be placed where best suitable. Fig. 12 is attached to the wall. Fig. 11 is used for the same purposes as Figs. 11 and 12, but is more compact.

By using stands such as have been described, considerable space can be utilized that would otherwise be wasted when articles are placed on the floor. They also prolong the lives of patterns, as nothing does more harm to these than having to leave them lying about the shop when not in actual use. The stands also save time and labor that is spent in looking for castings in the cleaning shop, while the stands for patterns, pattern plates and cores will enable workmen searching for such articles to locate them without any great delay.

A Place for Pattern Plates

By F. West

The storing of patterns is generally a trying problem, for even at best, there is always sure to be *something in the road* when a certain pattern is wanted. The pattern storage loft or vault might be defined as a tool room where there is a continuous increase or change of tools. As to the form of these tools, it can be said that it is so varied in size and shape as to make the use of uniform and easily accessible racks an impossibility. Uniformity, however, is one of the favored items in a foundry that uses a large number of plate patterns.

A PLACE FOR PATTERN PLATES WHEN NOT IN USE IN THE FOUNDRY

For taking care of these, probably the old-style shelf method is in most general use. As this has its disadvantages, the hinged-rack system, shown in the accompanying illustration, has been developed in one of our up-to-date and well managed foundries. This system gives every pattern plate a place that can be easily indexed, and it is possible to get to each individual plate without disturbing more than one other. Generally, the plates are so located that there is no need of touching any other plate in order to reach the one wanted.

From the illustration it will be noted that the system consists of a series of hinged racks composed of two leaves on each pair of hinges. This particular storage is located along a heavy wall of concrete in an inter-traffic subway of the plant. Heavy cast iron verticals are hinged to the wall. From these project horizontally, six cast arms, two grooves on each side. These grooves have a width with clearance for the edge of the plates to slide in. A strip of wood in the top groove forms a smooth surface on which the plates slide and rest, and these strips are a means of adjusting the width of the spaces to suit that of the plates. As the arms are made the length of two plates, when placed end to end, each set of double frames makes a place for 40 pattern plates.

Charcoal as Fuel for Cupola Melting

By W. J. Keep

Question: — We would like to obtain some information regarding the use of charcoal as a cupola fuel in place of coke. Our furnace is 30 inches inside diameter and we would like to know the height of the bed above the tuyeres when this fuel is used. Also kindly advise us what the height of the succeeding charges of charcoal should be, the number of pounds to be contained in the first charge of iron, the succeeding charges of iron and charcoal, and the ratio of efficiency between coke and charcoal.

Answer: — After making up the sand bottom of the cupola add sufficient charcoal to extend to a height of 20 inches above the top of the tuyeres; then take it out of the cupola and weigh it. Make a hoop 30 inches in diameter, 6 inches high, fill with charcoal and weigh the contents. Break

the pig iron into short pieces and have your scrap no larger than the broken pigs. Place into the hoop one layer of pig iron, lay it as close as possible and weigh this material. This will give you the weight of the pig charge; scrap charge used for this mixture should be one-fourth more than the pig iron charge. The melting ratio will be 3 to 4 of iron to 1 of fuel, while if using coke in the same cupola, your ratio would be 6 to 1.

Unfortunately, you did not state your reasons for desiring to use charcoal, but the only one that we can assign is to obtain castings low in sulphur.

A few years ago I was compelled to make low sulphur castings and the problem was investigated by a series of experiments, using a cupola of the same size as the one which you employ. I secured some by-product coke containing sulphur below 0.05 per cent and purchased iron containing a low content of sulphur. No scrap was used. The result was exceedingly satisfactory, the sulphur in the castings not exceeding 0.05 to 0.06 per cent. The blast pressure was 7 ounces. We used limestone broken to about one-half the size of an egg and added a heaping double handful to each charge. The slag was tapped as soon as it would run, which was about the fourth charge. The charges consisted of 700 pounds of coke on the bed, 300 pounds of iron with 50 pounds of coke, and 300 pounds of iron on the succeeding charges. It might be advisable to secure a carload of low sulphur coke, which can be used for the bed with charcoal for the succeeding charges. However, if you use charcoal for the bed, lay the shavings and kindling, add a small amount of soft wood and then the bed of charcoal. Charge iron and fuel to the charging door before lighting the fire. If you use charcoal on the bed you will have to exercise great care to prevent burning out the bed entirely before the iron melts.

(Owing to the fact that little or no information on the subject of melting iron in the cupola with charcoal as the fuel is available in foundry literature, we would be pleased to receive an outline of the methods and experiences of other foundrymen who have used charcoal as a melting medium.—*Editor*).

Chill and Shrinkage of Cast Iron

By R. A. Pitman

REFERRING to the articles by W. J. Keep in the February and by A. S. Dowler in the March issue of *The Foundry*, wherein is discussed the question of how long a car wheel will remain in contact with its chill ring, it seems that this is another point on which the foundryman needs the positive and definite evidence obtained by the use of the permanent mold.

During experiments with these molds, we have poured 750-pound car wheels and removed them from the molds at various intervals, from the almost incredibly short time of 45 seconds after pouring, to 3½ minutes thereafter. These wheels were removed from the mold and suspended by their chill rings until they dropped out by reason of the shrinkage. This always occurred between 3½ and 4 minutes after the end of the pouring, and up to the time when they dropped out by themselves, it was found to be absolutely useless to try to force them out by driving with a heavy sledge. The small differences appeared to be due to differences in the temperature of the iron at the time of pouring.

We find with gray iron, that when the metal is poured into the molds at the lowest possible temperature, that is, when it begins to get mushy, it will shrink much slower, and chill very much less than when it is poured at a very high temperature and in a highly fluid condition. This is noticeable in cases where a metal core is to be withdrawn from the casting, the cool metal allowing a much longer time interval between the filling of the mold and the time when the core is caught by the shrinkage and immovably held.

Many times it has been demonstrated that by pouring the iron into the mold in a mushy condition, and allowing it to remain in contact with the comparatively cold metal of the mold, until black, no chill would result, while if the same metal were poured into the mold very hot and fluid, and allowed to remain for only a few seconds, it would result in white chilled iron throughout the entire thickness of the walls of a casting 5/16-inch thick.

The Chill Phenomena

The differences in the speed of shrinking and the depth of chill are both probably due to the difference in the heat conductivity of the metal when in a mushy condition and when in a more fluid condition. The hot and fluid metal will naturally give up its heat to the mold or chill faster than the mushy or cooler iron, and the depth of chill in a given iron is controlled by the time required for the metal to pass through the range of temperatures at which the white crystalline structure is formed. To make this time short, heavy metal chills are used at points where white chilled iron is required.

Again, total shrinkage, being dependent upon the amount of graphite formed, is also partially dependent upon the time interval during which the casting is passing through the range of temperatures at which the combined carbon is changed to the graphitic, since, if small amounts of molten iron are dropped into water and cooled instantly, no graphitic carbon will be formed and the iron will be chilled through, while practically all of the carbon will be changed to graphitic if the same iron be cooled slowly enough.

Depth of chill also is affected in some classes of molds by the speed of pouring, since iron cannot be chilled while it is flowing. If the mold is of such form that the chill is covered by a shell of metal with a layer of moving metal behind it during the time of pouring, then too slow pouring will have the effect of reducing the metal back of the shell covering the chill, to a mushy condition from which it will not chill so readily, while very rapid pouring, by getting all the metal into the mold in a fluid condition, will tend to increase the chill.

It is evident, therefore, that if the castings are to be poured at varying temperatures and at varying speeds, final results cannot be expected to be entirely uniform, even with the best of care to keep the chemical mixture exact.

Other Solutions of Foundry Difficulties

By C. E. Lyall

On page 262 of the July issue of *The Foundry* was published an article entitled "Blow-Holes in Castings With Remedies for Preventing Them". My suggestions follow: Under no circumstances use oil on molds of any description; place your gates on the heaviest part of the castings; locate

the flow-off on the flanges opposite the pouring gates; build up the pouring gate high enough to continue the flow off process until the metal shows signs of becoming dull; the sand should be fine and open, the molds should be well-vented and the sand should not be too moist; the iron should be hot; the flask should be clamped while ramming up the mold so as not to shut off the vents; use clean 72-hour coke and an ample amount of fuel should be employed in melting, as hot iron is desirable at any cost.

Hard Iron Casting Troubles

On page 266 of the July issue of *The Foundry* was published an answer to an inquiry asking for a flux to prevent gas holes in hard iron castings. If these castings are poured with hand ladles, a piece of aluminum, the size of a bean, should be placed in the bottom of the ladle. If the metal is poured from a bull ladle holding from 150 to 200 pounds of iron, place a piece of aluminum about the size of a hickory nut in the bottom of the ladle upon which the metal is tapped. Use 72-hour coke, fine open sand, vent well and do not ram the mold too hard. Place 60 pounds of crushed limestone on the bed before charging the iron. At a point in about the middle of your first charge place 6½

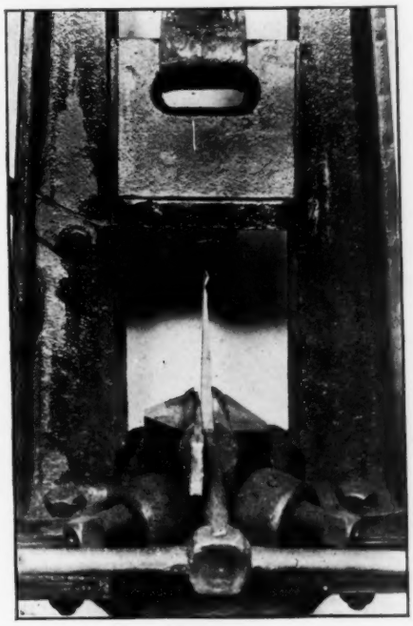


FIG. 1—TEST WEDGE READY FOR THE FIRST BLOW

pounds of 80 per cent ferro-manganese. This represents our daily practice for making wire-drawing dies and hard iron castings of any description.

On page 272 of the July issue of *The Foundry* is published an answer to an inquiry regarding the elimination of shrink holes in machine tool castings. I would suggest the use of 400 pounds of pig iron containing 2.75 per cent silicon, 450 pounds of machinery scrap and 150 pounds of

FIG. 2 — REPEATED BLOWS HAVE FAILED TO BREAK THE BAR

sprues. Make four charges out of this mixture and have the cupola very hot before melting. If the cupola bottom will hold a 1,000-pound charge when melted, place 10 pounds of 80 per cent ferro-manganese in the middle of the charges and also place 60 pounds of crushed limestone on the bed. Wherever possible, place a riser or a flow-off to prevent the accumulation of gas in the mold. To eliminate slag and dirt, pour the molds from the bottom. The iron should be hot and the mold should be faced with a weak facing for light castings and a strong facing for medium and heavy castings.

Walker Wedge Testing Machine

Malleable iron, since the first record of its manufacture in Europe, by Reaumur in 1772, and its discovery in the United States by Seth Boyden, has been one of the most misunderstood as well as one of the most useful of the various forms of iron. Even at the present time many fallacies concerning it persist among those who direct industries in which its use is an important factor. To lay some of these ghosts and to demonstrate the value of malleable as an ideal metal for castings requiring ductility as well as strength, the American Malleable Castings Association maintained an exhibit at the meeting of the Master Car Builders' Association and the Railway Master Mechanics' Association, held at Atlantic City, N. J., in June. A feature of this exhibit was the Walker wedge testing machine, which strikingly showed the ductility and shock-resisting qualities of malleable iron. This machine is a double hammer which delivers a 70 foot-pound blow. On its anvil is gripped a cast malleable iron wedge, 6 inches long, 1 inch wide, ½-inch thick at the bottom and tapering to 1/16-inch thick at the top. This wedge receives repeated blows from the hammer. Fig. 1 shows the wedge in position for the test, with its top slightly bent ready for the first blow. In Fig. 2 the wedge is seen after repeated impacts and Fig. 3 illustrates it completely curled into spiral form, but not broken or cracked. Further tests, in which a wedge which had ⅛-inch machined from either surface was used, showed identical results, disproving the fallacy that the strength of malleable iron lies in its skin.

Electric Brass Melting Furnace

The Chicago Bearing Metal Co., Chicago, has closed a contract with the Snyder Electric Furnace Co., 53 West Jackson boulevard, Chicago, for the installation of an electric furnace for melting brass. It will have a 12-hour capacity of 5,000 pounds and will be in-

FIG. 3—VISUAL PROOF OF DUCTILITY AND SHOCK-RESISTING QUALITIES OF MALLEABLE IRON

stalled under guarantees as to operating cost and loss by volatilization. The guarantee has been made that the volatilization loss will not exceed 1½ per cent and it is claimed that in operation the loss will be considerably less.

Training Embryo Foundry Leaders in School

An Outline of the Course at Wentworth Institute Which Involves a Large Amount of Practical Work

By E. A. Johnson

THE progress, growth and ultimate development of the foundry industry must depend in the long run, as in every industry, upon two principal factors. First we rely on the intelligence, the ability and the supply of the rank and file workers. Parallel with this and of equal importance to the future success of the foundry industry, is the ability, leadership, foresight and wisdom of those who are controlling, managing and directing the destinies of our American foundries and foundry operations.

FIG. 1—THE FIRST STEPS IN AN INTERESTING PIECE OF DRY SAND WORK—TWO ADVANCED STUDENTS LEVELING UP THE PATTERN FOR A LARGE LATHE BED

FIG. 2—PUTTING FINAL TOUCHES ON MOLD WHICH IS READY FOR DRYING PROCESS BEFORE RECEIVING COPE—TWO FLAT GATES NEAR BOTTOM AND TWO HIGHER UP ON EITHER END

The leader in the modern foundry has a great variety of responsibilities. His position is a complex one. It includes getting business, managing men, the upkeep of complicated mechanical equipment, the development of better methods of foundry practice, the improvement of quality of product and the reduction of costs.

All of these things are of great importance and it is worth while for us to stop to consider what kinds of ability he must have in order to be successful. He should have mechanical skill and ability to use his own hands in all the different kinds of work that come within the line of business in which his foundry is engaged, or into which its natural growth and extension may carry it. He must be able to judge what is a fair day's job, and in reality he has to be a teacher who can encourage the men to do better than they have been doing and better than they are doing in his competitors' shops. If he has not a comprehension of the elements of mechanical skill that enter into each job, his competitors are going to have the advantage over him along this line.

I recall an instance where a railroad had been having constant trouble in getting castings of the quality that it required. The eccentrics and eccentric straps especially gave trouble. Blame was placed upon the iron, but no one knew the exact trouble nor how to correct it. As a matter of fact, the iron was of good quality and the molding was all right with one exception. The gating was the cause of the entire trouble. The manager of the foundry was an excellent business man, but his foundry lost those particular castings and also the entire business of the railroad because he did not know a simple mechanical detail of an ordinary job of molding. Illustration after illustration might be cited to show the advantage of ability to do one's self the things that one must direct others how to do.

The foundry leader, too, must have technical knowledge of the kind which will enable him to organize the work in the shop; he should have ability to judge what jobs may be run as machine jobs with profit, what kinds of machines to use in each case and how best to mount the patterns. The size and shape of the flask to be used, the depth of copes and drags required, the method of gating, etc., in order to get the maximum production in the shortest possible time and with the least possible losses through misrun castings and other causes, should receive his consideration.

Ability Required

He must also have ability to plan match-plates and match-work of the various kinds to be used in connection with molding machines; or otherwise to effect savings in time and increase the output. And in a thousand and one other ways he must have accurate,

A paper which was presented at the Chicago meeting of the American Foundrymen's Association.

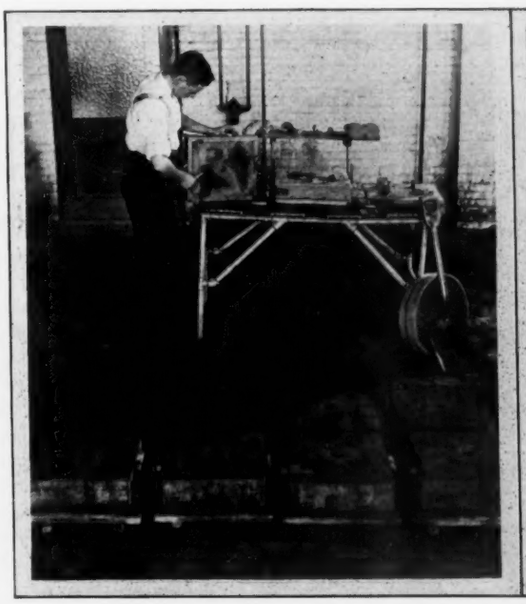


FIG. 3—BENCH MOLDING PRACTICE—THE STUDENT IS ACCUMULATING PRACTICAL EXPERIENCE AND USEFUL TECHNICAL KNOWLEDGE

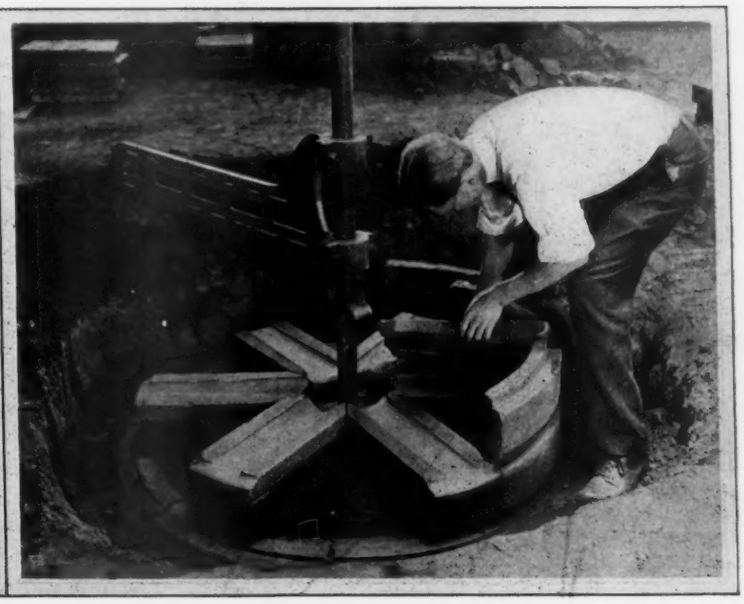


FIG. 4—SETTING UP A DRY SAND JOB—PART OF A STUDY IN THE COMPARATIVE EFFICIENCY AND COST OF DIFFERENT METHODS OF MOLDING FLYWHEELS

detailed, technical knowledge in each branch of his business, to meet emergencies. To illustrate: The driving gear on a heavy duty printing press is an important casting. There is danger of spongy, weak metal at the base of the teeth near the point where the arms join the rim. One of the largest jobbing shops in the middle west lost a very considerable amount of excellent gear blank business simply because the manager did not know the importance of reducing the size of the fillets on the patterns at this point and thus avoiding porous metal which is caused by unequal cooling.

In producing heavy castings the leader in the modern foundry should know how to determine rapidly and accurately the amount of metal to run different kinds of castings; the proper pouring temperature of the metal which will produce the best results for every grade; the kinds and qualities of sand best suited for each variety of work; and the proper facings to be used. He must also understand the cupola in all its functions. He must be thoroughly familiar with up-to-date methods of mixing, of charging, and of melting; and he must know the effects on the metal when the conditions of melting are varied. He must know the relations of pressure and volume of blast, of depth of bed, height of melting zone, tuyere openings and time,—all as applied to the melting of metal in the cupola.

To cite one more illustration, of a case where an experience with mixtures and judgment in cupola practice was worth thousands of dollars. One of the best drop forge men in the United States was having trouble with the dies that he used for forging heavy front axles of automobiles. The machining of these dies cost $700. It was an

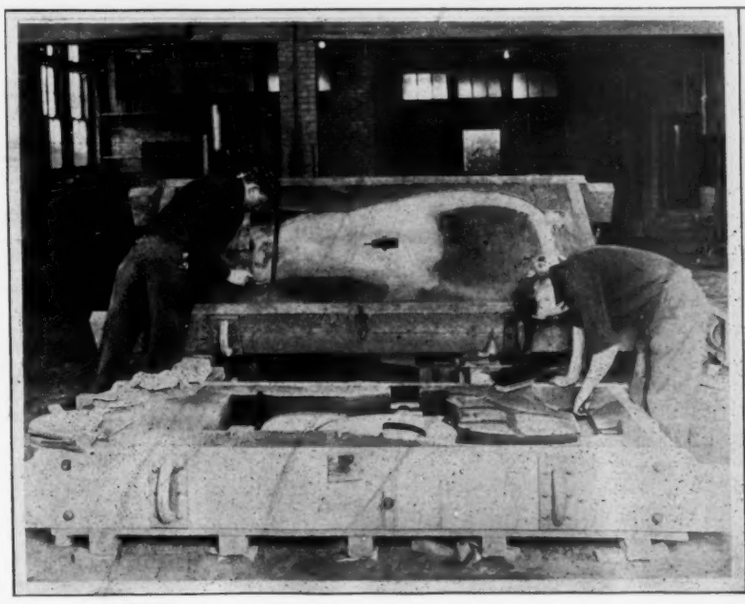


FIG. 5—FINISHING A GREEN SAND MOLD FOR A BAND SAW FRAME IN THE SHOPS OF WENTWORTH INSTITUTE—THIS MOLD COMPLETE, READY FOR POURING, REPRESENTS ONE DAY'S WORK FOR TWO STUDENTS

FIG. 6—ACCURATE CHEMICAL ANALYSIS IS THE KEY TO THE SOLUTION OF MANY OF THE MOST DIFFICULT FOUNDRY PROBLEMS

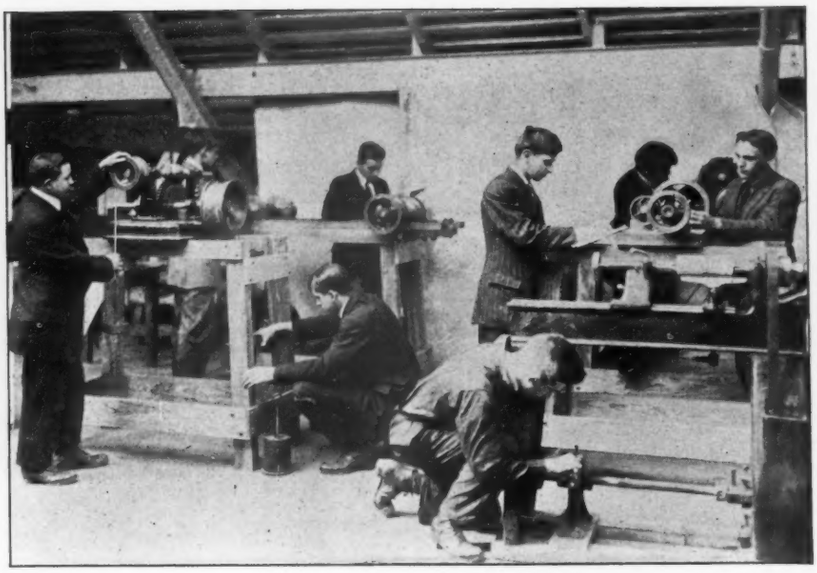


FIG. 7—WORKING OUT A FEW PRACTICAL PROBLEMS IN GEARING

extra heavy job and the regular grade of castings that he had been getting stood up for only two dozen axle forgings. At this rate the axle forgings were expensive indeed. A foundry competing with the one that was regularly furnishing these die blocks was told of the trouble and was given the privilege of furnishing a trial set of blocks. By making a special mixture, planned to be low in graphitic carbon and therefore low in silicon, but high in manganese, a different result was obtained. Great care, too, was used to keep both the sulphur and phosphorus low. The charge was planned so as to get an extraordinary high temperature; and as a final precaution, in order to insure the best possible result, about 10 per cent of vanadium steel clippings were added to the charge. The steel clippings cost less than ordinary cast iron scrap, but the results obtained with that set of die-blocks enabled the competing foundry—through just a little accurate technical knowledge—to build up an enviable business and a reputation in die-block work. At the same time it received 75 per cent above the market rate for this product.

It is not necessary for everyone in the foundry industry to have this kind of technical knowledge, but somewhere in every plant there should be a leader, at least one, who has mastered these technical details and who can solve such problems as those involved in the example that I have just described.

Our leader, too, has got to have an engineering appreciation of the generation of steam, power transmission, applied electricity, compressed air, ventilation, etc., subjects covering pretty nearly the whole field of what is now regarded as the profession of mechanical engineering, for now-a-days foundry equipment touches all of these fields. He must also have a sufficient mastery of the pattern maker's art to enable him to determine when savings may be effected by altered patterns that will simplify molding. I remember a pattern from which hundreds of castings had been made in one shop. The work was transferred to another foundry because the castings were not up to the required standards, and deliveries were not prompt.

These castings were in the shape of a ring about 4 feet in diameter with a heavy flange to which steel plates were to be riveted. The whole trouble was with the cored rivet holes through the circular flange. The pattern had 96 separate stop-off prints placed on the inside face of the pattern, leaving 96 narrow necks of sand between them. The setting of these particular cores always resulted in some crushing and always required patching, which consumed time, and resulted in rough surfaces on the casting where smooth work was required; it also caused a high percentage of loss. These castings weighed about 400 pounds and one casting made in this way was considered a day's work for a molder and a helper.

When the pattern arrived in the new shop it was altered by placing a continuous flat print over the whole inside face of the ring. For the 96 cores six new cores were substituted, each having the proper number of projections. In setting these larger cores only a few moments were required. The castings came out with the desired smooth surface and the work was so simplified that failures were almost entirely eliminated. One molder and a helper with the altered pattern made three castings per day.

Problems of this sort are met with constantly in practice. Each one of you knows from his own experience dozens of similar examples, especially in the jobbing shop. The man in charge should always be ready to devise changes that will effect economy not only for his own plant but also for his customers' plants.

The core room and cleaning department each offers its problems, and the whole fields of chemical and metallurgical engineering with their problems of temperature, heat value, combustion, and the relationships between the chemical and physical properties in the foundry materials and foundry products are also matters that must come within the accurate appreciation of the modern foundry leader with an eye to progress. Speaking generally, manufacturers today

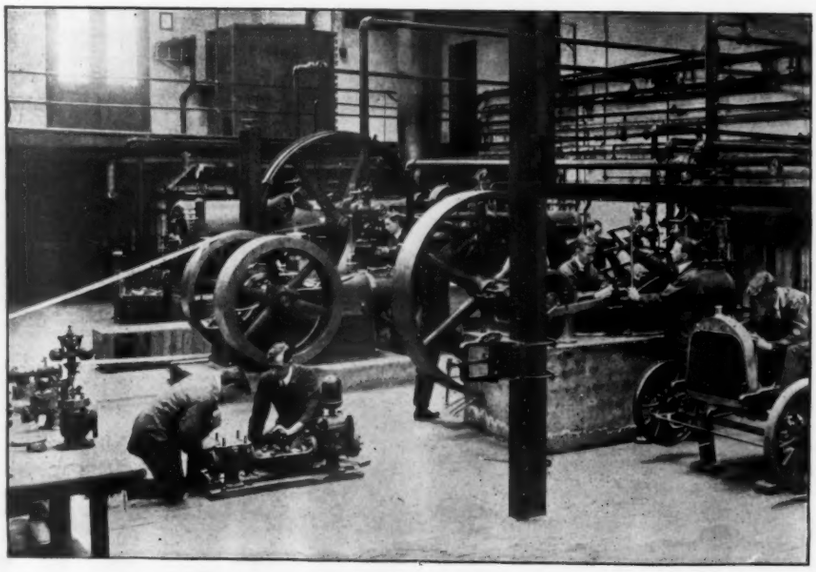


FIG. 8—ESSENTIAL PRINCIPLES OF STEAM ENGINEERING, COMPRESSED AIR PRACTICE, AND POWER TRANSMISSION ARE TAUGHT IN CLASS ROOMS AND WITH THE AID OF LABORATORY EQUIPMENT

everywhere appreciate the importance of all the things that I have outlined and recognize the advantages to be derived from their adoption. They understand the value of scientific control of foundry operation. And yet, while this is true, there is still a large percentage of foundries where old methods of operation are in use. This fact cannot be questioned. Foundrymen everywhere are familiar with the reason. They are forced to continue operating in the old way simply because of their inability to get men with the training and with the leadership required to carry on the work in accordance with the best accepted standards of the trade.

It is not necessary to argue the point. It is self-evident that the apprenticeship system, as it has been carried on in many foundries, does not produce men who have the proper training to succeed in managing a plant in accordance with the modern ideas that we all are prepared to accept. It is also self-evident that practical experience alone is no longer sufficient. Rule-of-thumb methods will not solve the kind of problems that I have tried to suggest.

Wentworth Institute, Boston, Mass., realizing this situation, has determined to offer a new two-year course designed to train men to fill this need. The vital importance to the foundry industry of a sufficient supply of such men is so great that I feel sure that a brief description of the course will prove of interest.

This new course is intended to train young men exclusively for advanced positions in the foundry industry, for those positions which require a combination of skill, intelligence and technical knowledge. It is planned to give both a broader practical training and a more thorough comprehension of the scientific principles that underlie modern foundry practice than can be obtained through practical experience in most commercial shops today.

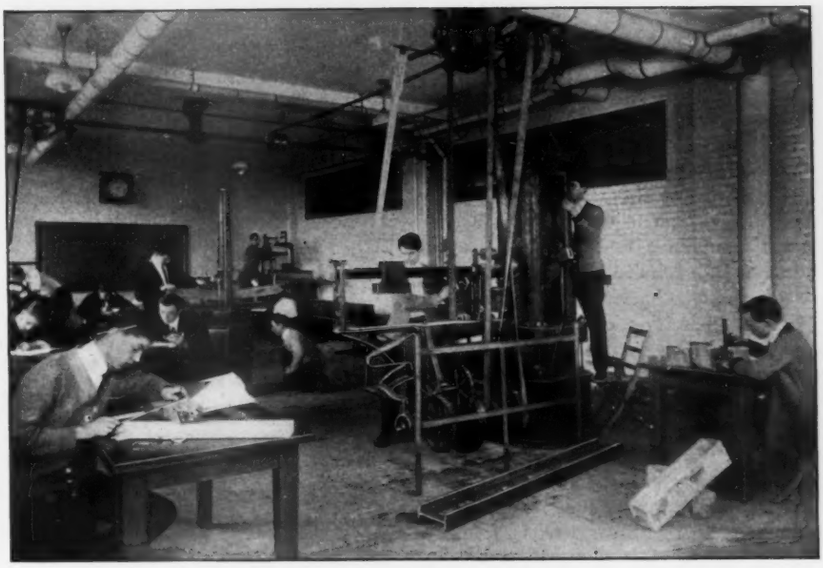


FIG. 10—TESTING THE PHYSICAL PROPERTIES OF MATERIALS

The work of the new course, which we call foundry management and operation, is divided into seven general headings.

First, Shop experience.—Three-eighths of the entire time during both of the two years is given to gaining shop experience in bench and floor molding for iron, brass and other alloys, and in machine molding, core making, finishing, and in cupola management. The plan is to include all the common types of work that are met with in the best modern foundries. By carefully economizing the men's time and by seeing that there is no wasted effort through repetition and doing unnecessary kinds of work from which little benefit would be derived, it is confidently believed that in two years as much or more skill and experience can be given than young men would get in a commercial shop in a long apprenticeship. And if they have already had a considerable amount of practical experience—then this practical training, added to what they already have, will be of an advanced character and will enable them to take up grades of work that would come entirely outside the range of ordinary experience.

Second, Text book study, reading and recitations, practical talks and lectures.—A great deal of the kind of information that I have tried to describe in the first part of this paper can be successfully and rapidly imparted through reading and study and by lectures and practical experiments and demonstrations given to a class of mature and earnest students by an experienced teacher. Our plan includes a systematic course of this kind extending through each of the two years of the course.

Third, Drafting and design. — The third important subdivision in the course includes a variety of training given on the drawing-board. There are many problems that can be solved better with drawings than in any other way; and a foundry leader of the type that I am trying to describe must have facility with his lead pencil and ability to express his ideas on paper, to sketch the things that he wants done, and to design the details of foundry appliances and foundry equipment, if he is to get the best results. We are making provision for training along this line.

Fourth, Rapid and accurate computations. — A knowledge of plain mathematics is necessary in the foundry business. The computations that are required include not only estimates of

FIG. 9—AT WORK IN ELECTRICAL LABORATORY—FOUNDRY EXECUTIVES MUST BE FAMILIAR WITH ELECTRICAL APPARATUS

costs and quantities of material but also a great variety of calculations involving the use of formulas and more or less advanced mathematics. A systematic course of instruction is therefore planned, involving computations of just this kind, including such branches of mathematics as are essential. Care, however, is taken to omit text-book subjects that do not find daily application in the foundry industry.

Fifth, Applied science. — The fifth principal subdivision of this new course of instruction is planned to cover all those principles of applied science which enter into the foundry industry, and general principles of engineering, such as steam generation, power transmission, applications of electricity and compressed air, strength and stiffness of materials, etc., which every foundry manager must understand if he is to become a leader of the type that we have been discussing. We regard this feature of the course as extremely important and are giving a considerable amount of time to it. We have a special laboratory equipped for this kind of work and the students in the new course will be drilled, through lecture and recitation and through experiments in the laboratory, in all of these departments of applied science.

Sixth, Foundry chemistry. — Perhaps the most original part of the work, so far as school practice is concerned, is the instruction that has been planned in foundry chemistry and chemical and metallurgical engineering, including, of course, the questions of combustion and the effects of temperature. The importance and value of this part of the work alone would require a special article. We have three laboratories devoted to this part of the work.

Seventh, Scientific management. — My space is too short for me to describe all the details, as they have been worked out, but there is one other point that I feel I ought to mention. All the way through this paper I have referred to the type of man for whom this course is planned as "*The Leader.*" Leadership is a quality we certainly want to develop. It can be developed like any other quality, through practice, and therefore we have definitely planned to give the students in this new course opportunity to obtain systematic experience both in planning work and in directing the work of others. They will be expected to act as foremen supervising, first small operations, and as they gain experience, assuming larger and larger responsibilities.

Our experience in other courses has demonstrated that this kind of foremanship training does develop the qualities of initiative, and qualities of resourcefulness, courage and self-confidence which, taken together, we call leadership.

Bridging of a Cupola

By W. J. Keep

Question:—Will you kindly advise me how to prevent the cupola from bridging without the use of the top tuyeres? Our furnace is lined to 48 inches with a 4:1 area. I have tried to melt on several occasions without the use of the upper tuyeres, but the results have been unsatisfactory. It seems that during the first hour the iron comes down exceedingly hot, melts rapidly, the tuyeres are bright, but after this period trouble begins. The iron enters the tuyeres and conditions go from bad to worse until the end of the heat. Our average heat is 47,500 pounds. We charge from 1¾ to 2½ hours before blast. The bed extends to a height of 24 inches above the top of the lower tuyeres. All

FIG. 11—SPECIAL APPARATUS FOR DETERMINING THE PERMEABILITY OF MOLDING AND CORE SANDS

charges are 1,000 pounds and our melting ratio is 1:9. Limestone is used for a flux. When the four top tuyeres are open no trouble is experienced.

Answer:—My suggestion is to use the four top tuyeres or to do anything else that will insure good iron. If you will allow a 4-inch bosh of slag to build out above the tuyeres or line the cupola that way, the iron will not drop into the tuyeres. Furthermore, the tuyeres should be so shaped that the iron will not remain in them. If you slag freely you should experience no trouble from bridging, even with so large a heat. I can see no objection to the upper row of tuyeres if they help to produce good results and with such large heats they certainly should aid in increasing the speed of melting. I think you ought to be congratulated on your method of operations, which certainly cannot be improved.

The Control of Sulphur

By W. M. Carr

In an article published in the May number of *The Foundry*, page 189, entitled "Controlling the Sulphur in Melting Pig Iron," I neglected to discuss the character of the fuel that may be used in the operation of an open hearth furnace.

The fuel to be employed will depend upon the locality of the plant, as well as economical considerations, and will rest between artificial gas (such as producer, retort, or coke oven), liquid fuels, such as oils and tar, or natural gas, and the several costs will have to be compared with that of coke, the fuel of the cupola. In some sections of the continent, coke is expensive because of freight charges, but oil or natural gas may be plentiful and cheap; in such districts, therefore, the cupola may be discarded entirely, because the open hearth can be operated to much better advantage than the cupola.

In any event, the physical properties of pig iron treated in an open hearth are superior to those of cupola iron, but this fact is not generally recognized or known by foundrymen. In my practice, using an open hearth for iron castings in cases where trial orders had demonstrated the more desirable properties of the section, it was a simple matter to secure premiums for repetition orders, ranging from ¼ to 1½ cents per pound.

Install Blystone Mixers

Included in the core shop equipment of the Putnam Machine Co.'s foundry, Fitchburg, Mass., illustrated and described in the July issue of *The Foundry*, is a core sand and facing mixer furnished by the Blystone Mfg. Co., Cambridge Springs, Pa. This machine, which is direct-connected to a 3-horsepower motor, has capacity for mixing ¼ cubic yard of sand per minute. Due to the satisfactory results obtained by the use of mixers of this type, the Blystone company has received an unusually large number of repeat orders from concerns which previously had installed one or more of the machines. Such an order recently was telegraphed by Dodge Bros., Detroit, with the result that one of the mixers, weighing 1,600 pounds, immediately was shipped by express from Cambridge Springs. This is the third Blystone mixer to be installed at the Dodge plant. The two previously purchased have been in service practically 24 hours a day, the core room being in continuous operation.

THE BRASS FOUNDRY

Fatigue of Copper Alloys

By Ernst Jonson

IN PREVIOUS papers the writer has pointed out that the occurrence of so-called season cracking in brass rods is conditioned by (1) high initial tensile stress in the surface of the rod, and (2) by corrosion of the metal; also, that a brass rod may develop cracks of the same nature as season cracks when stressed beyond the initial yield point by an external load, instead of having initial stress set up by the cold drawing of the rod, and that such cracking is not peculiar to one kind of brass but that all kinds of forgible brass are subject to it.

At the time of the previous writing, the following brasses were tested and cracked when etched with ammonia, while under stress greater than the initial yield point: Cast manganese bronze from two foundries, plain-extruded manganese bronze, rolled-and-drawn manganese bronze, plain-extruded naval brass, drawn naval brass, and plain-extruded Muntz metal. No cracking has been observed where high stress and corrosion did not co-exist. From these facts the conclusion was drawn that the ordinary ultimate strength of brass is developed only when the metal is broken so quickly that cracks do not have time to develop, and that when a stress exceeding the yield point is applied for a considerable time the metal will fail by cracking.

Guide for Investigations

The working hypothesis formed for the purpose of co-ordinating these facts and to guide further investigations is as follows:

In copper alloys there are microscopic flaws. When the tensile stress approaches the yield point these flaws are opened sufficiently to admit corrosion. This corrosion weakens the edges of the flaws and causes them to increase under the continued action of the stress, and thus a continuous crack is formed which gradually increases in depth. When the crack has so reduced the cross-section that the stress on the remaining solid portion exceeds the rod's ultimate strength, the latter will break. In order to more definitely determine the magnitude of the stress at which cracking begins another series of tests has been started. Each test was made as follows: A tension test specimen of 1 inch diameter and 8 inches length, with a reduced diameter of 0.8-inch and 6-inch gage length, was placed in the testing machine. A sheet steel cup with a 1-inch hole in its bottom was put on top of the lower grip so that the end of the test specimen passed through it, and the cup was filled with strong ammonia. Some absorbent cotton was tied to the test specimen so as to keep it wet by capillarity, and the cup and test specimen were covered by a conical paper hood so as to confine the ammonia fumes. A stress of 10,000 to 17,000 pounds per square inch, increased by increments of about 3,000 pounds per square inch at intervals of a day or more, was applied to the test specimen. Under the higher stresses the test specimen continued to stretch for a considerable length of time, and in such cases this time was added to the interval between the additions of load.

The test specimen was examined before each increment of load was applied. When the first crack was seen the test was concluded, because experience has shown that a crack once started will increase in extent until the test specimen fails, even if the load is not increased. The cracks were similar to season cracks; the largest was generally found where the test specimen emerged from the liquid. In some cases this crack was the only one present; in others there were quite a number of cracks distributed over the length of the test specimen.

In order to discover what alloys are subject to failure by cracking all the usual copper alloys will be tested.

The stresses at cracking are as follows:

Kind of metal.	Stress at cracking, pounds per square inch.
No. 1.—Manganese bronze, plain extruded	27,000
No. 2.—Manganese bronze, plain extruded	23,000
No. 3.—Manganese bronze, plain extruded	23,000
No. 4.—Naval brass, plain extruded	20,000
No. 5.—Muntz metal, plain extruded	23,000
No. 6.—Gun metal, cast 88 Copper, 10 Tin, 2 Zinc	23,000

It appears that the stress at which cracking occurs bears some relation to the elastic limit, but this relation has not yet been definitely established. Present results indicate that the metal is liable to cracking when the stress exceeds the elastic limit by 5,000 pounds per square inch.

Tests Being Made

Four specimens of manganese bronze have been under excessive stress for many months but have been protected from corrosion. These specimens have not cracked. Some manganese bronze studs which were found cracked in valves in the Catskill aqueduct were made up with red lead. One test bolt, therefore, was embedded in red-lead paste and drawn up to a stress in excess of the initial yield point. In the part of the bolt where the red lead remained liquid, the surface of the metal was stained and cracks appeared.

Two specimens of plain-extruded manganese bronze were corroded, one in ammonia, the other in a mixture of ferric chloride and hydrochloric acid, and then broken in the testing machine. The specimens gave ultimate strengths of 65,300 and 60,000 pounds per square inch, and elongations of 43 and 42 per cent, respectively. These results, which are quite normal, indicate that corrosion does not generally injure brass when it is not under stress while being corroded.

The results thus far obtained may be summed up as follows:

1.—Prolonged excessive stress does not injure the metal when it is protected from corrosion while under stress.

2.—Corrosion does not generally injure the metal when not accompanied by excessive stress.

3.—Corrosion accompanied by prolonged stress less than 20,000 pounds per square inch does not generally injure the metal.

4.—Corrosion by ammonia accompanied by a prolonged stress of 20,000

Presented at the Atlantic City meeting of the American Society for Testing Materials.

pounds per square inch or more causes cracking, similar to season cracking.

5.—The foregoing results apply to manganese bronze, naval brass, Muntz metal and gun metal.

6.—No copper alloy has as yet been found to which these results do not apply. It is possible, however, that such exceptions exist, either on account of higher elastic limit or greater resistance to corrosion.

Practical experience with season cracking indicates that ammonia is not the only corrosive agent which causes cracking in overstressed copper alloys, but that the corrosion which results from the common conditions of exposure also produces cracking. Ammonia, therefore, may be regarded as a representative corrosive agent, although it attacks these alloys more quickly than the average exposure. The test with ammonia may be regarded as an accelerated test which in a few hours produces results which ordinarily would require days, weeks or months to develop, but which do not differ in kind from the results of the more common forms of exposure. Since all copper alloys in practical use are exposed to various corrosive agents it is probable that sooner or later all metal in use will be affected by corrosion, just as much as the test specimens in the tests here reported. Therefore, it follows that the results obtained from these tests may be expected wherever copper alloys are permanently stressed over 20,000 pounds per square inch.

It seems, therefore, that we are justified in drawing the conclusion that forgible brass and gun metal, and probably copper alloys in general, should never be stressed in practice to 20,000 pounds per square inch. In other words, 20,000 pounds per square inch should be regarded as the practical ultimate strength of this group of materials. The working stress should therefore be taken as a safe fraction of this stress, say 5,000 pounds per square inch.

An important corollary of this conclusion is that the process of manufacturing rods of copper alloys must be so planned that no appreciable initial tensile stress is left in the surface of the rod, and that the proper inspection of drawn rods must include strain measurements. Another important corollary is that copper alloys cannot be depended on where the stress is indeterminate, for in such cases it may or may not exceed the safe stress. These alloys, therefore, should not be used for important bolts when drawn up tightly.

Discussion by G. K. Burgess and P. D. Merica

Mr. Jonson has undoubtedly made a distinct contribution to our knowledge of the behavior of brasses under what might be called accelerated service conditions. His work leaves little doubt but that brasses under stresses are in general subject to corrosion by ammonia or ammonium hydroxide in such a way that they fail at loads much under their ultimate strengths, and indeed at loads below those at which they fail under the same stress fatigue conditions but without corrosion.

There is another well-known example of the corrosion of such 60:40 brasses, namely, the corrosion by sea water of Muntz metal sheathing for ships' bottoms. Doubtless if Mr. Jonson had used sea water instead of ammonia he would have obtained the same kind of results, possibly, however, not in as short a time.

Of the six tests, which he mentions, all but two were carried out on extruded brass, which is very possibly initially stressed, a fact which would possibly obscure the results somewhat. Most interesting are the cases of manganese bronze heated to near the melting point and quenched, and of gun metal, cast. It may be noted in this connection that the yield point of this latter metal ranges from 15,000 to 17,000 pounds, whereas the specimen as corroded did not fail until 23,000 pounds was reached.

Mr. Jonson draws the important conclusion that any agent which corrodes brass at all will in time produce the same effects (cracking), as ammonium hydroxide, that in other words the ammonia test is a perfect acceleration test. This raises the question: Why has not a great deal of brass of this sort, in the shape of castings, forgings, and rod failed in service, since some of it has undoubtedly been stressed in service up to 20,000 pounds per square inch and been at the same time subject to corrosion by air or water or both? Data bearing on this question would do much toward deciding upon the validity of Mr. Jonson's conclusion.

It may be mentioned that there is one case, fairly well-known, in which one type of corrosion does produce failure in the material and others, during the course of which a greater weight of corrosion product is found, do not.

Thus, the action of dilute acids (in pickling or otherwise) as well as that of alkalies (the latter according to some unpublished work of one of us) upon steel produces brittleness and cracking, whereas steel rusted in the ordinary way is still sound.

There is undoubtedly room for much investigation along these lines, and in the course of such investigation statistics should be gathered bearing on the behavior of such materials in service. From a study of these statistics, together with tests where possible of the materials concerned, much can be done toward settling this important question—what are the safe working loads for brasses subject to corrosion?

Classification of Old Metals

ONE OF the most perplexing problems confronting the brass foundryman, involves the purchase of old metals. This is due to the widely varying opinion existing among users and dealers regarding the proper classification of the various grades of scrap. Also, the producer of this material has been at a loss to know how to dispose of his accumulation to the best advantage, and a chaotic condition has existed in the trade.

Last year the National Association of Waste Material Dealers was organized and among its purposes was the adoption of standard practices to govern all transactions. A metal section of this society was formed for the purpose of considering conditions in this branch of the business and as a result of its deliberation the following standard classification for old metals was adopted:

Delivery—(*a*)—Delivery of more or less on the specified quantity up to 2½ per cent is permissible.

(*b*)—If the term "about" is used, it is understood that 5 per cent more or less of the quantity may be delivered.

(*c*)—Should the seller fail to make deliveries as specified in the contract, the purchaser has the option of canceling all of the uncompleted deliveries or holding the seller for whatever damages the purchaser may sustain through failure to deliver, and if unable to agree on the amount of damages, the arbitration committee of the National Association of Waste Material Dealers, appointed for this purpose, will determine the amount of such damages.

(*d*)—In the event that buyer should claim the goods delivered on a contract are not up to the proper standard, and the seller claims that they are a proper delivery, the dispute shall be referred to the arbitration committee of the National Association of Waste Material Dealers, to be appointed for that purpose.

(*e*)—A contract for a carload, unless otherwise agreed, shall mean the minimum quantity recognized by the official classification tariff of the district in which the seller is located.

(*f*)—A ton shall be understood to be of 2,000 pounds, unless otherwise specified.

Heavy copper—This shall consist of copper, not less than ⅛-inch thick, and may include trolley wire, heavy field wire, heavy armature wire that is not tangled, and also new copper clippings

and punchings, untinned and clean, and copper segments that are clean.

No 1 copper wire—To consist of clean untinned copper wire not smaller than No. 16 B. & S. wire gage, to be free from burnt copper wire, which is brittle, and from all foreign substances.

No. 2 copper wire—To consist of miscellaneous clean copper wire such as of necessity would be taken out of the heavy copper and the No. 1 copper wire, but to be free of hair wire and burnt wire which is brittle.

Light copper—Shall consist of the bottoms of kettles and boilers, bathtub linings, hair wire, burnt copper wire which is brittle, roofing copper and similar copper, free of visible iron, brass, lead and solder connections, old electrotype shells, and free of excessive paint, tar and scale.

Composition or red brass—Shall consist of red scrap brass, valves, machinery bearings, and other parts of machinery, including miscellaneous castings made of copper, tin, zinc and ore lead, no piece to measure more than 12 inches over any one part, to be free of aluminum and manganese, also free of railroad boxes, cocks and faucets, gates, pot pieces, ingots and burned brass.

Railroad bearings—Shall consist of railroad boxes or car journal bearings, must be old standard used scrap, free of yellow boxes, plastic and similar bearings, also iron-backed boxes, and must be free of babbitt; also free of excessive grease and dirt.

Cocks and faucets—To be mixed red and yellow, free of gas cocks and beer faucets; shall be at least half red.

Heavy yellow brass—Shall consist of heavy brass castings, rolled brass, rod brass ends, brass screws and tinned or nickel-plated brass tubing; to be free of iron and dirt, and must be in pieces not too large for crucibles; no piece to measure more than 12 inches over any one part. Must also be free of aluminum manganese mixtures. Condenser tubes shall not be considered as heavy brass.

Light brass — Shall consist of light sheet brass, forks and spoons, miscellaneous brass that is too light for heavy, but to be free of any visible iron, gun shells containing paper or iron, loaded lamp bases, and of clockworks.

New brass clippings—Shall consist of the cuttings of new sheet brass to be absolutely clean and free from any foreign substances.

Brass tubing — Shall consist of brass tubing, free of nickel-plating, tinned, soldered, or tubes with cast brass connections. To be sound, clean tubes, free of sediment and condenser tubes.

No. 1 composition turnings — To be free of aluminum, manganese, plastic and yellow brass turnings, not to contain over 2 per cent iron, to be free of grindings or foreign material, especially babbitt, and free from adulterations made to resemble metal. Turnings not according to this specification subject to sample.

No. 1 yellow brass turnings—Shall consist of strictly rod turnings, free of aluminum, manganese, composition and tobin turnings. Not to contain over 3 per cent of iron or of oil or other moisture, to be free of grindings and babbitts. To avoid dispute, to be sold subject to sample.

No 1 pewter.—Shall consist of tableware and soda fountain boxes, but in any case must test 84 per cent tin. Siphon tops to be treated for separately.

Auto-radiators — To be classed separately, must be free of iron.

Zinc—Must consist of clean sheet and cast zinc, also cast batteries to be free of loose oxide and dross, sal-ammoniac cans, and other foreign materials.

Tin foil—Shall consist of pure foil free of lead compositions and other foreign ingredients and matters.

Electrotype shells — Must be hand picked and free of dross.

Packages—Shall be good strong packages, suitable for shipment, and each package to be plainly marked with the gross and tare weights, so that when packages reach their destination their weights can be easily checked. When goods are not packed according to the above specifications and shipper wants his rejections returned, the cost of labor shall be charged to the shipper.

Recovery of Secondary Metals in 1914

STATISTICS of the secondary metal recovery in the United States in 1914 as compiled by J. P. Dunlap of the United States Geological Survey, were published in the June, 1915, issue of *The Foundry*, page 232. Brief reference was made to the total recovery which aggregated $57,039,706 last year as compared with $72,786,027 in 1913. A bulletin, containing further details on this subject has recently been issued, which contains much valuable information on the subject of metal recovery. The term *secondary*, applies to metals recovered from scrap, sweepings, skimmings, drosses, etc., and this is used to distinguish them from the metals derived from ore, which are termed primary metals. The reports to the geological survey do not include the large quantity of iron and steel remelted, nor gold, silver, nickel and platinum.

The decline in the recovery of secondary metals in 1914, the decrease being $15,746,321, is attributed to depressed trade conditions, as the manufacturing and railway centers contribute the bulk of the metal wastes. As shown by the accompanying table, the recoveries of lead, zinc, tin, copper, antimony and aluminum made from scrap metals, drosses, etc., in 1914, aggregated about 287,000 short tons. As these secondary metals sell at prices only slightly lower than new metal and displace an equivalent quantity of primary metals, they must be considered in any estimate of stocks available for consumption in any year. For a few purposes, requiring especial purity of material, it is necessary to employ primary or virgin pig metal, but as a general rule secondary metals can be used in whole or in part. In fact, most foundries, in order to compete for business successfully, must and do use secondary material, at least in part, and hence they purchase scrap metal and remelt it with primary pig metal or with composition ingot. The secondary smelters by handling large quantities of all kinds of scrap are able so to classify their material as to produce continuously alloy metals of uniform composition suitable for use in work of different classes.

It has proved impossible to separate the statistics for secondary metal recovered from clean scrap made in the ordinary course of manufacture from the statistics of secondary metal recovered from drosses and ashes and from scrap or old metal that had entered the trade as manufactured articles and been used and discarded. An estimate is given of the clean copper and brass scrap on the basis of replies from the larger secondary smelters and refiners, but no classification made for any considerable number of the dealers or smelters is at present available.

The total quantity of secondary copper recovered in 1914, on the assumption that the brass remelted had an average copper content of 70 per cent, was 127,882 tons, of which 15,964 tons (about 2,700 tons less than in 1913) was recovered by plants refining primary metals and the remainder by plants treating only secondary materials. The copper produced by smelters of the latter class includes 36,658 tons of pig copper, 5,934 tons of copper in alloys other than brass, and 69,326 tons of copper in remelted brass. These figures indicate a decrease for 1914 of about 2,700 tons of pig copper and 50 tons of copper in brass and a decrease of about 5,600 tons in alloys other than brass. At least 40,000 tons was recovered from clean scrap made in the course of manufacture of copper and brassware, so that only about 77,800 tons was obtained from ashes, cinders and scrap, or from material that had actually been used and discarded. According to the bureau of foreign and domestic commerce, the exports of scrap brass, fit only for remanufacture, for the calendar year 1914 were 10,420 tons, and the imports were 2,565 tons. Many railways sell or turn in the larger portion of their brass and copper scrap and other metal waste to dealers in part payment for new ma-

terial, but the reports received show that the railways utilized in their own shops and foundries over 12,069 tons of brass, in addition to 700 tons of copper and 1,362 tons of copper in alloys other than brass.

The production of copper from secondary sources in 1914 was equal to about 16.7 per cent of the refinery output of primary copper in the United States from all sources, or about 22.2 per cent of the primary copper smelted from domestic ore.

Secondary Lead

The secondary lead recovered in 1914 amounted to 61,062 tons, or about 11,800 tons less than in 1913. The secondary lead recovered as pig lead decreased about 3,700 tons, although the recovery of secondary lead made by those smelters whose product is mainly primary metals was slightly more in 1914 than it was in 1913. The recovery of lead in alloys decreased more than 8,000 tons, compared with 1913.

RECOVERY OF SECONDARY METALS IN THE UNITED STATES IN 1913 AND 1914

Metal.	1913. Quantity, short tons.	1913. Value.	1914. Quantity, short tons.	1914. Value.
Secondary copper, including that in alloys other than brass	66,980	$20,536,068	58,556	$15,435,362
Remelted brass	99,315	24,651,969	99,038	21,054,300
Secondary lead	33,104	6,409,392	29,337	4,762,836
Recovered lead in alloys	39,730		31,725	
Secondary spelter	50,005	6,019,776	42,969	4,782,066
Recovered zinc in alloys other than brass	3,743		3,914	
Secondary tin	6,415	12,567,379	4,535	8,887,158
Recovered tin in alloys	7,763		7,912	
Secondary antimony	45	401,963	1	444,844
Recovered antimony in alloys	2,660		2,645	
Secondary aluminum	2,198	2,199,480	2,791	1,673,140
Recovered aluminum in alloys	2,456		1,731	
Total	.....	$72,786,027	.....	$57,039,706

This decrease in both pig lead and lead in alloys was undoubtedly due to slackened building operations, railroad traffic, and manufacturing. A large portion of the recovered lead in alloys was derived from old babbitt, solder, type metals, and white metal drosses. The main sources of secondary pig lead are old pipe, lead cable, battery lead, and lead lining of acid tanks. Regular smelters reported the recovery of 11,108 tons of lead from scrap lead and scrap antimonial lead.

The total output of secondary lead was equal to 11.3 per cent of the primary refined lead produced in the United States in 1914, compared with 15.2 per cent in 1913. It was exceeded by the primary domestic lead output of only three states—Missouri, Idaho and Utah.

The output of secondary zinc (including that in brass) amounted to 71,642 tons and equaled 20.3 per cent of the production of primary spelter in the United States in 1914, compared with 23 per cent in 1913. The recovery was about 8,000 tons less than in 1913, of which decrease more than 5,000 tons was the loss in redistilled spelter from drosses and skimmings. The zinc recovered in alloys other than brass amounted to 3,914 tons, compared with 3,743 tons in 1913. Of the 42,969 tons of secondary zinc recovered as spelter, 20,545 tons were obtained by redistillation from drosses and skimmings. Of this quantity 6,580 tons were obtained by smelters whose principal source of zinc is from ore. This was about 1,800 tons less than the recovery from drosses and skimmings in 1913. In addition to the 31,723 tons of remelted and redistilled spelter it is estimated that at least 8,000 tons of zinc chloride was made and likewise about 32,800 tons of the zinc pigment lithopone (containing approximately 32 per cent zinc sulphide and oxide). The zinc used in both of the last-named products is derived almost altogether from zinc drosses and skimmings. The exports of zinc drosses, which only amounted to 28 tons in 1913, increased to as high as 2,526 tons in 1914. Three smelters in New Jersey, New York and Pennsylvania, which treat only drosses and skimmings, used large graphite retorts of 600 to 800 pounds capacity instead of the small clay retorts used by smelters treating ore or mixed ore and drosses. The many uses of zinc drosses and skimmings create active competition for their purchase. Considerable zinc is recovered by sweating, and the residues are then sold for redistillation. The secondary spelter varies in quality just as the spelter derived from ore does, but a large portion of the secondary spelter is reported to be of excellent quality.

Secondary Antimony

The production of secondary antimony, of which all but one ton was recovered in alloys, decreased from 2,705 short tons in 1913 to 2,646 tons in 1914. The only antimony ore of domestic origin smelted in the United States in 1914 was about 60 tons from Mill City, Nev., which was mined in 1907. The regular smelters reported the recovery of 140 tons of antimony contained in antimonial lead scrap. The principal materials refined or remelted which contained antimony as an alloy were hard lead drosses, babbit, solder, pewter and type metal. The 1914 imports of antimony as metal in ore or as oxide amounted to 7,528 tons, and the recovery from secondary sources was equal to 35.2 per cent of the imports. The secondary recoveries of antimony were 117 tons more than the antimony content of lead ores of domestic origin smelted in 1914.

Secondary Tin

Apparently there were no domestic tin ores smelted in the United States in 1914, though some tin concentrates were shipped from Nome, Alaska, to Singapore, Federated Malay States, for treatment, and there was considerable agitation for the domestic smelting of both Alaskan and Bolivian tin ores. An increased output from Alaska may result in establishing a tin smelter on the Pacific coast. This condition makes secondary tin an important factor in supplying domestic consumption. The secondary tin recovered in 1914 was equal to 26.2 per cent of the tin imported, as metal or as oxide, into the United States during the year (47,525 short tons). Secondary tin recoveries decreased from 14,178 tons, valued at $12,567,379, in 1913 to 12,447 tons, valued at $8,887,158, in 1914. The quantity recovered as tin was 4,535 tons and that in alloys and chemical compounds 7,912 tons. It will be noted that the secondary tin in alloys increased about 150 tons, and that the secondary pig tin decreased about 1,900 tons, a condition partly attributable to the large quantity of tin chloride made from clean tin scrap.

The recovered tin in alloys includes the tin content of products of several plants made from clean tin scrap. This included some tin oxide, putty powder, etc., but consisted mainly of tin chloride. Two forms of tin chloride are handled commercially—stannic and stannous salts. Stannic chloride is usually sold either as a water solution, called bichloride of tin, or as an anhydrous sirupy liquid, termed tetrachloride of tin, and is used principally in the silk industry. Stannous chloride is sold in the form of crystals and is used in dyeing and calico printing. The dry chlorine process was used in recover the tin from the clippings in some places. In others reverberatory furnaces were used to remove the tin coating, and a large quantity of tin was recovered in the form of a tin powder by the electrolytic treatment of clean

scrap, the powder being sent to secondary smelters. The largest recoveries of tin were made from the scruff and drosses that occur in making tin and terne plate and amounted to over 4,000 tons.

In 1914 and in 1913 only one firm reported using old tin containers, from which the tin and solder were first sweated and the black plate was then remelted to make sash weights. Comparatively large quantities of tin scrap and old tin cans are used in the western mining regions for the precipitation of copper from mine waters. However, the tin coating of the scrap does not enter into the reaction and is lost entirely. It was not possible under prevailing conditions of lower tin prices and a stagnant market for the scrap black plate to utilize used old tin-coated containers for the recovery of the tin.

The ordinary can used for food seldom carries more than 2 to 2.5 per cent of tin coating, and gasoline cans and tin buckets have a much lighter coating. It was stated by operators of detinning plants that there had been a decline in the thickness of tin coating on much of the tin plate marketed in 1914. The principal alloys in which secondary tin was recovered were solder, bearing metals, bronze, pewter and electrotype metal. Recovery of secondary aluminum as pig aluminum or in alloys in 1914 amounted to 4,522 tons, valued at $1,673,140, as compared with 4,654 tons, valued at $2,199,480, in 1913. The quantity recovered in alloys amounted to 1,731 tons, nearly all of which was an alloy of 92 per cent aluminum and 8 per cent copper.

The greater part of the secondary aluminum was recovered from clean clippings and borings and was probably all used in making castings. It is stated on good authority that aluminum remelted from clippings can not be utilized for sheet aluminum. The reason is believed to be that a layer of superficial oxide is formed on the sheet, which causes planes of separation in an ingot made from clippings. Such ingots when rolled will crack.

PROBLEMS OF THE BRASS FOUNDER

What To Do and How To Do It

Trolley Wheel Difficulties

We are experiencing considerable difficulty in making trolley wheels, owing to the porosity, the defects appearing to be largely in the cope section of the casting. The mixture we use consists of 50 per cent old wheels and 50 per cent new metal. Green sand cores are used in the molds, both in the hub and for the grooves.

There is only one cause for this difficulty and that is defective melting. If your trouble were caused by hard-rammed molds, improperly tempered sand, etc., the surface of the casting would indicate this. If the molds, sand and metal supply are above suspicion, it follows that the method of melting is at fault.

Always use charcoal in all pots of molten metal and be certain that the surface is entirely covered. Care should be exercised in properly charging the metal and in your case sufficient scrap should be placed in the bottom of the crucible to half fill it and on top of this the copper should be charged. To prevent the new copper from protruding above the top of the pot, a crucible ring should be employed. This consists of a section of an old pot without bottom and is set on top of the crucible. This will permit charging all of the metal into the crucible at one time with the charcoal on top. Never place charcoal on the bottom of a cold pot because submerged charcoal makes spongy castings, as the oxygen of the air in pores of the charcoal, when the latter is heated, combines with the carbon, forming carbon monoxide and carbon dioxide. These are absorbed and partially retained by the metal and, therefore, it is advisable never to permit the charcoal to become entangled in the molten mass. Melt the metal as quickly as possible and when ready for the mixture add the phosphorus first, following with the white metals, and stir thoroughly. If the melting operation is carried on in oil-fired furnaces having swirling air currents that sweep away or burn off the charcoal, a flux of broken glass should be used or some other substance that will form a slag and will protect the metal from oxidation.

Furthermore, when the metal is excessively oxidized, phosphorus will not prevent porosity. In fact, porous phosphor bronze castings frequently are produced. If the porosity persists, adopt even more rigid precautions against oxidation and use on top of the metal from one-half to one old dry battery per 100-pound charge. The dry batteries contain oxide of manganese and a sufficient amount of manganese is reduced by the charcoal to serve as an efficient deoxidizer for non-ferrous metal.

Composition of Manganese Bronze

Kindly give us the composition of manganese bronze and gun metal; also, we would like to know how to make an acid solution for dipping brass castings after removal from the sand.

Many different methods are employed for making manganese bronze and there are widely varying opinions regarding this alloy. Some formulas specify high manganese and aluminum contents, without iron, while others recommend high manganese, high aluminum, high iron and low zinc and others suggest low manganese, low aluminum, a moderate iron content and high zinc. The following mixture is classified among the latter type of alloys and will render good service: Copper, 56 pounds; zinc, 42 pounds; iron, 1.5 pounds; tin, 1 pound; aluminum, 0.5 pound and 80 per cent ferro-manganese, 0.5 pound. To make the alloy, melt a greater portion of the copper under a cover of charcoal, allow it to become very hot, add the ferro-manganese in granular form, stir thoroughly, then add the iron in the form of tin plate or use electrolytic or ingot iron sheets, stir the bath thoroughly and add the aluminum, which will help in effecting the solution of the iron and the manganese, and follow with the reserve copper, which should be sufficient to cool the metal to a point where the zinc can be added without excessive volatilization. The zinc is added next, followed by the tin. The metal should be ingoted and when remelted, should possess the following physical properties: Ultimate strength, 80,000 pounds per square inch and above; elastic limit, 40,000 pounds per square inch and above; elongation, 21.3 per cent on 2 inches and reduction of area, 22.1 per cent.

Gun metal is composed of copper, 88 per cent; tin, 10 per cent and zinc, 2 per cent. An aqueous solution of hydrofluoric acid is best for removing sand from castings, as it attacks the sand but not the metal.

Modern Practice in Electrical Arc Welding

The Science of This Work is Discussed and Suggestions Are Included Governing Its Employment in Casting Manufacture

By John A. Randolph

THE science of welding dates back to ancient times. The primitive method, using hammer, anvil and forge, however, is limited in its scope, and is not practicable for mending cracks or joining seams, for work on large castings, or for any of the heavier forms of welding where the contour and dimensions of the piece must be maintained. For work of this character, the more modern methods employing the oxy-acetylene gas flame or electricity are used. In the gas and electrical methods the contiguous pieces of metal are heated to the melting point and then fused together. To increase the strength, homogeneity and efficiency of the weld, a filler of outside metal is usually melted and fused into the joint. In electric welding, two general processes, the resistance and arc methods, are followed. This article will treat of the arc method.

STRENGTH OF ARC WELDED JOINTS

Samples and preparation.	Breaking strain, pounds.	Efficiency of joint, original piece = 100.	Nature of breakage.
Original piece of steel plate.....	58,600	100.00	Near end of piece
Lap joint, arc welded.....	54,800	93.52	Outside weld
Lap joint riveted and welded.....	54,200	92.50	Outside joint
Butted joint, arc welded.....	47,800	81.57	Through weld
Lap joint riveted only.....	35,000	59.72	In rivet holes

Three processes are followed in arc welding. Each offers distinct advantages for certain classes of work. In each case, the metal is heated to the required temperature by an arc drawn between two electrodes. Direct current is used in all cases, alternating current not being suitable for arc welding. In the Bernardos process, which is widely used, the work to be welded furnishes one terminal for the arc. The other electrode is formed by a piece of carbon or graphite arranged so as to be readily movable. The positive side of the circuit is connected to the work, for two reasons, first, because that side of the arc is generally 75 per cent hotter than the negative, and second, because a large number of carbon particles would be carried into the weld if the carbon were made the positive electrode. This deposit of carbon particles would result in excessive hardening of the metal. In the Slavianoff process, the work comprises one electrode, as in the Bernardos method. The other electrode, however, consists of a piece of filler metal. The action of the arc softens the metal of the movable electrode and causes a small quantity to be carried into the weld, adding homogeneity to the joint. Owing to the absence of carbon, the metal of a weld made by this process always remains sufficiently soft for machining or hand-working. This method is used for overhead welding in fire boxes, tanks and other situations where it would be difficult to run in the filler metal by hand.

In the Zerener process, both electrodes are entirely independent of the work to be welded. They are of carbon and are arranged in the form of a V. The arc passing between the two carbons is forced into the work by the field of an electro magnet. The arc acts like a flame upon the work. Any direct current source of supply can be used for arc welding, providing the voltage is high enough. The pressure on the circuits used for light and power is generally 110 or 220 volts. This is much higher than is necessary for welding, the pressure required for this purpose being normally not more than 50 volts. If an electrical circuit of standard voltage is to be used directly for welding, a series resistance must be placed in the welding circuit to reduce the voltage. This results in an excessive loss of power through heating the resistance.

To reduce resistance losses to a minimum where a standard voltage supply is used, an indirect method is

For the illustrations accompanying this article we are indebted to the General Electric Co., Schenectady, N. Y.

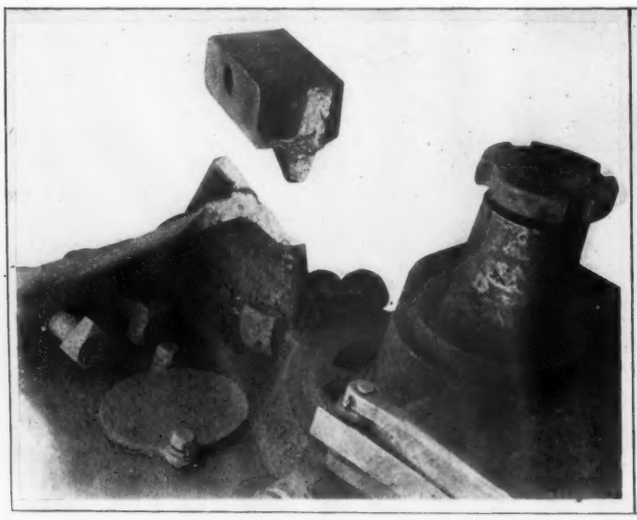
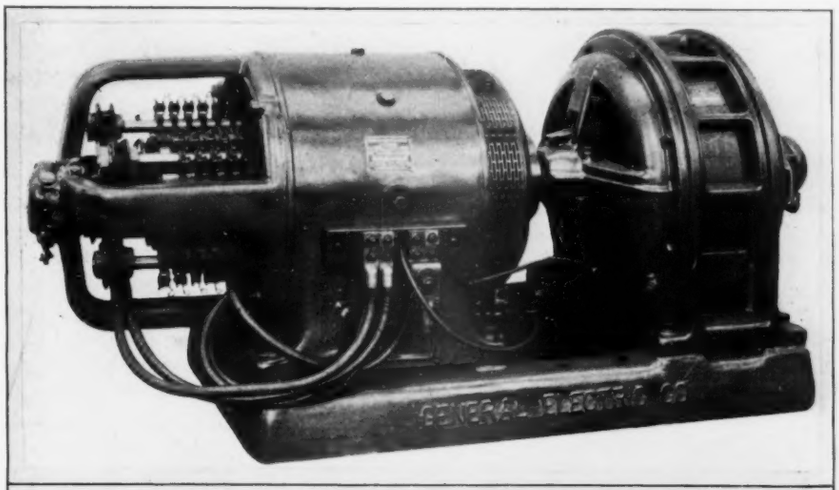


FIG. 1—GEAR CASE WITH BROKEN SUSPENSION LUG

FIG. 2—SUSPENSION LUG REPAIRED WITH ELECTRIC ARC

employed, in which the motor generator is interposed between the supply circuit and the weld. The motor is connected directly to the supply source, the generator being wound to produce current with the range of voltage required at the arc. The pressure is varied by regulating the field excitation of the generator. Lower voltage is thus secured with no material loss between the supply source and the weld. Either an alternating or a direct current circuit can be used for driving the motor generator, by simply using an alternating or direct current type of motor, as required. By the use of a switchboard and bus bars, any number of independent welding circuits can be fed at the same time. This enables an unlimited number of operators to work from the same generating equipment. With the electric arc, it is claimed that 18 feet of seam can be welded in an hour at a total cost of 90 cents, or 5 cents a foot. The welding of plates, ½-inch thick, by an electric arc costs 15 cents a foot; with plates an inch thick the cost is 35 cents per foot. The results of a series of tests on riveted, arc welded joints, as published in *The Boiler Maker*, February, 1915, are shown in the accompanying table. Electric arc welding is widely used in foundries, machine shops and steel-working plants. It is especially valuable for mending cracked shafts, broken castings, cracked lugs, and the like. It is also used extensively for cutting purposes. In railroad shops, the arc welding process has proved of service in mending flues, fire boxes, frames, and for the restoration of material that has been worn away.



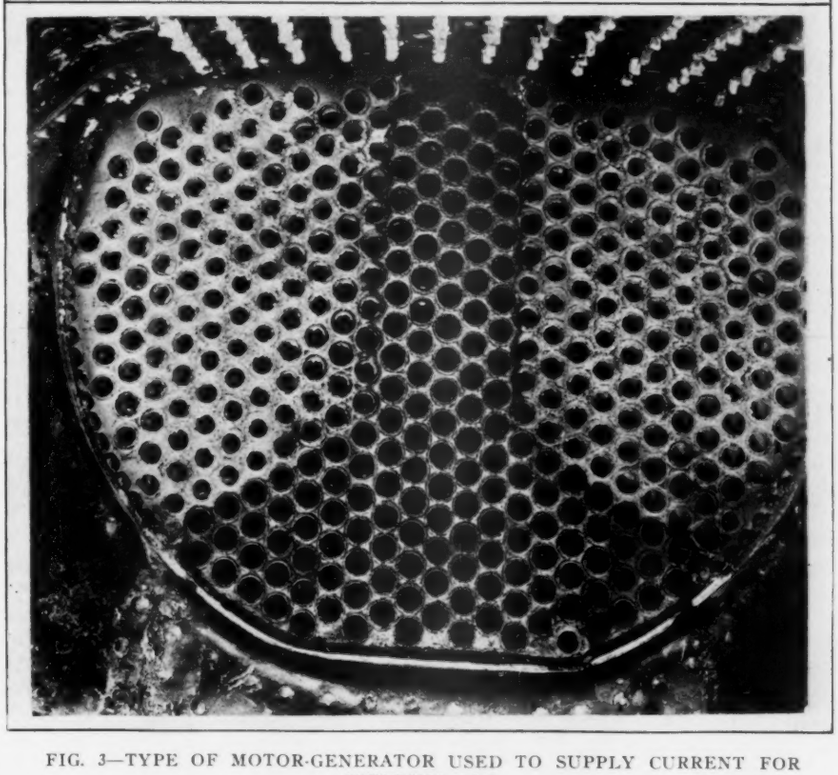


FIG. 3—TYPE OF MOTOR-GENERATOR USED TO SUPPLY CURRENT FOR WELDING ARC

FIG. 4—LOCOMOTIVE BOILER TUBES WELDED BY ARC

Brazing Outfit for Narrow Band Saws

By F. W. Barrows

If a band saw is expected to do good work, the saw itself must be kept in good condition; for no matter how nicely the machine runs, poor work will be turned out if the saw is dull, is set too wide, or is crooked. As it requires considerable skill to set and file the saw, by hand, so that it will cut smoothly and follow a line closely, there may be some excuse, where no filing or setting machine is provided, for letting a saw run too long before resharpening; still, it is easier to make a dull saw sharp than it is to make a crooked saw straight, especially when the crook is caused in brazing, as nine-tenths of them actually are caused. The ends of the saw may have been clamped out of line in the brazing fixture, causing a crook which becomes evident both to the sight and touch as soon as the saw is put into use, and this only can be corrected by breaking and re-making the joint. It is quite possible to hold the saw straight in the ordinary brazing fixture furnished by the manufacturer of the bandsaw machine; but when the tongs, brought to a white heat, are applied to fuse the brazing metal, their weight, resting on the heat softened saw, will cause a crook; this is effected more easily as the muscular strain of squeezing the joint deadens the fine sense of touch which might otherwise prevent this. Again it may be found, after the tongs have been cooled and the joint is set, that the tongs are brazed fast to the saw, in extreme cases requiring a cold chisel and hammer to cut them apart that they may be used separately. Then the jaws of the tongs, by successive heatings and the cold chisel treatment, become roughened and have to be faced and refitted until they will bear on the whole length and width of the joint. In some pattern shops the man who is so unfortunate as to break a saw is looked upon as little better than a criminal, and is censured much more severely than is merited, because of these difficulties, sure to be encountered in repairing the saw. To avoid all this the fixture illustrated was designed, and when put into service was found to be a specific cure for all these troubles, it being only necessary to fit the joints nicely, before attempting to braze them,

to insure that the saw should be straight after its end were joined for brazing. Referring to the illustration, the angle plate, *A*, rests upon the sleeves, *BB*. These sleeves slide upon the projecting arms, *CC*, of the swinging brackets, *D*, in end view, and each is provided with an upright post, *E*, over which hubs on the angle plate fit. The angle plate has four lugs, two on each side of the central gap, provided with thumb-screws for clamping the saw.

With this construction, the angle plate, with the saw clamped upon it, may be swung across the burning gas jet with a parallel motion; or by sliding upon the bracket arms, the saw is moved towards or away from the burner, until the joint is placed in the position most favorable for melting the brazing material.

The supply of gas is controlled by the handwheel at the top of the mixer, *F*, while the compressed air enters through the pipe at the side, furnished with an independent shut-off, by which the supply can be regulated to meet requirements. The tongs, *G*, normally held open by the spring, *H*, are pivoted upon a lug projecting from the rear of the angle plate, *A*. When closed upon the saw, they also close upon the pin, *J*, fixed in the lug which supports the tongs. This pin prevents the gripping strain from bending the saw by holding the closed jaws accurately in line. The gripping surfaces of the tongs, being held away from the burning gas until the silver solder is melted, are in no danger of being burnt and becoming roughened thereby, as the gas is shut off at the moment they are closed upon the joint.

Thus safeguarded, they will always remain flat and true. Then as they are never heated to the brazing point, they don't stick fast to the saw.

The apparatus is mounted on the plank, *K*, which is spiked fast to the wall at a convenient height. When in use, the loop of the saw rests upon the floor requiring no further support. The ends of the saw, each clamped at two points, are held exactly in line while the brazing metal is being fused by the gas jet, and the tongs are always ready for instant action.

The ends of the saw should be nicely fitted, that the joint, when finished, may be of the same thickness as the rest of the saw. The length of the splice should be proportionate to the thickness of the saw; for Nos. 14 to 18 B. & S. gage, ½-inch length is sufficient.

Brazing the Joint

Having the joint fitted, proceed as follows: The ends, one at a time, are clamped in the fixture with the back edge of the saw against the vertical surface, *L*, of the angle plate, using blocks of wood between the thumb-screws and the saw; one for each screw. The teeth are placed to the front, away from the burner, as the heat and blast tend to burn the points. The joint should be placed nearly central in the gap, and its position tested by closing the tongs before clamping. The gas is then lighted, to avoid any disturbance of the work after the solder and flux have been put between the two parts of the joint. Experience soon taught the user how much gas would be required and it was easy to adjust the supply by noting the size of the flame.

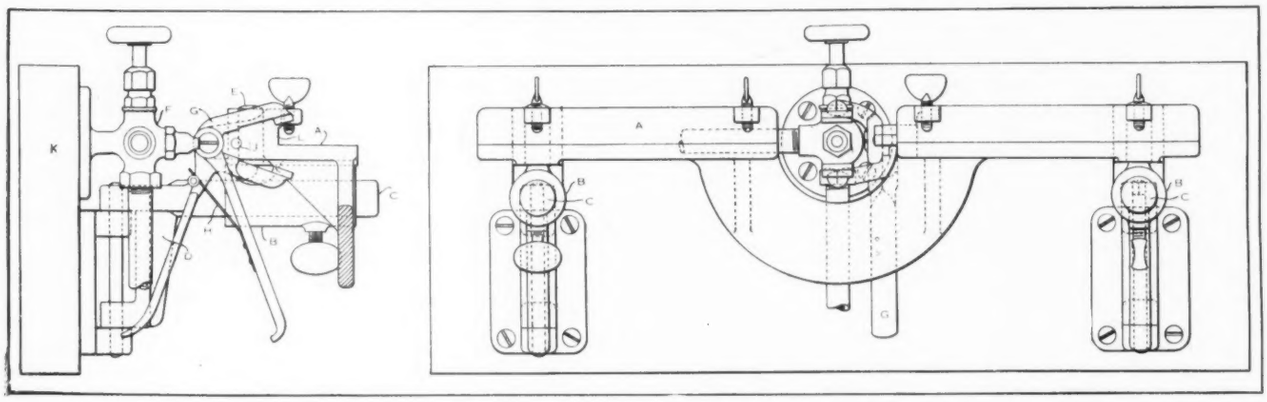
After the solder and the borax—the flux found most satisfactory—are in place, the air blast is turned on; then the fixture is manipulated to bring the joint into the desired position, where it is held by gripping the outer end of the left swinging bracket and the angle plate, with the left hand.

When the brazing metal flows, the tongs are cooled by the right hand, and the gas is at once shut off by the left hand, leaving the air blast to cool the joint, as it quickly does, while still held fast in the tongs.

The joints made by this fixture were much better than those produced by the white-hot, clumsy tongs previously used, and as the saws were not crooked by the weight of the tongs, fewer breakages occurred.

The favorable results produced are briefly and aptly summarized in the reply of the user, who, when questioned as to the utility of the apparatus, admitted that it was a good tool: "But we don't have much use for it, now'days."

Other fixtures may be arranged to slide upon the supporting arms of the wall brackets in place of the one illustrated; and as the burner, with proper adjustment, will generate heat sufficient to melt brass, the apparatus may be found useful for other purposes.



A FIXTURE FOR BRAZING NARROW BANDSAWS

Wants Soft Iron

By W. J. Keep

Question:—I require a very soft cast iron, easy to file, drill and machine. During the last month our iron frequently has been hard. The analysis is approximately as follows: Silicon, 3.90 per cent; phosphorus, 0.65 per cent; manganese, 0.20 per cent; sulphur, 0.065 per cent; combined carbon, 0.03 per cent and total carbon, 3.10 per cent. Lately the combined carbon has occasionally gone to 0.65 per cent. Lighter castings, however, as a rule show less combined carbon and are easier to machine than the heavier castings. We use by-product coke containing sulphur approximately 0.70 per cent. Our charges consist of 2,000 pounds of pig iron and 225 pounds of coke. The blast is normal and the castings are not shaken-out until cool. The only change in our practice is to reduce the tonnage from 18 to 5 tons. The cupola is lined to 48 inches.

Answer:—The silicon is altogether too high to obtain good castings. The silicon drives out the carbon and the latter should never be below 3.25 per cent and 3.50 per cent is better. Reduce the silicon to less than 3 per cent. Close the upper tuyeres of your cupola and light the fire two hours before the first iron is tapped.

A Practical Follow-Up System for the Foundry

Methods of a Large Eastern Foundry Which Successfully Keeps Track of Rush and Job Orders Are Described

By Theo. A. St. Clair, Jr.

A FOLLOW-UP SYSTEM for the foundry, or for any other manufacturing establishment, is designed primarily to enable the executive to keep in touch with the work in its progress through the shop, from the time of the arrival of the order in the office until the final shipment of the work has been made; to be able to tell, at any time, just what condition the order is in; what is being done and what has been accomplished toward its completion. In order to make a system of this kind thoroughly practical and effective, three vital factors must be considered:

First. — Simplicity, which involves paring down and eliminating all detail which does not bear directly upon the result to be obtained; the adoption of short cuts and an entire absence of "red tape".

Second. — Efficiency, which includes data so compiled, tabulated and indexed that it will enable the executive to ascertain accurately and intelligently, at any time, the progress of certain work through the shop.

Third. — Economy, meaning the maximum of such useful data, properly compiled, tabulated and indexed, at a minimum of clerical and other expense.

Much time and thought has been devoted to discussions of satisfactory shop "follow-up" methods, with the result that various systems have been tried, some of which have been successful and others the reverse; but for an all-around, practical system, adhering very closely to the principles mentioned above, the one in use in a large eastern foundry, at the present time, merits attention.

Two Principal Kinds of Products

The work which this shop produces might be said to be divided into two distinct classes, (1) castings made for the company's own needs and classes, (2) jobbing work handled for outside concerns. In order to get an idea of how this system is carried out, let us follow the course of an order through the shop.

Presuming this order to be one from an outside customer, it is first made out in duplicate on the form shown in Fig 1, which is printed on stiff paper, the duplicate Fig. 2 being on cardboard. These two forms are made up for convenience in tablets, four to the page. The order, when made out is "classed" and piece price record (if any) is noted. The classification, *A, B, C,* etc., depends on the intricacy of the casting and determines the price to be charged. The order next is entered on a sheet, Fig. 3, which forms part of a loose-leaf book. These sheets are not removed until full and then are taken out and filed away under name of customer. Each subsequent order is entered beneath the previous one; when an order is completed it is simply "crossed off" in red pencil, which easily distinguishes it from the unfinished items on the same page.

Card System Important

After being entered, as explained above, the order is filed according to the number it bears, with others from the same customer, in a tray provided for that purpose. The card is sent to the pattern clerk, who picks out the pattern and tacks the card thereon. It then goes to the foundry, with the pattern, for delivery to the molder by the foreman.

When the blast is on and when the molders have about completed their day's work, the foundry clerks collect the cards covering the jobs which have been worked upon during the day, marking thereon the date, molder's name, number of molds made and piece price, if one has not been set previously. These cards are sent in to the office where the clerks enter the data in their proper places.

The office card covering the order we have been considering is picked out from the tray, and the information on the molder's card—name, date, quantity made and piece price—is copied thereon. The order card is then sent to the shipping department and becomes a "shipping order", on which the shipping clerk records the shipments as made, defective castings, etc.

The molder's card is also copied into the loose-leaf book under the customer's name at the proper order number, as shown in Fig. 3. If completed, the molder's card is then filed away, under date completed, in trays provided for the purpose. If not completed, it is returned to the foreman of the department to which the class of work belongs. In the instance we are following it will be readily seen there are 10 castings yet due, so the card is returned to the foundry; to be collected again the following day. This operation is repeated until all of the castings are made.

If any castings turn out to be defective, the shipper makes out a "defective card", Fig. 4. These are made up of stiff paper in tablet form, five to the page. This defective card is turned in to the officer where it is entered in the "defective casting" column of the loose-leaf book, and then is sent to the foundry. The record of shipments is likewise entered daily under the "shipments" heading in the loose-leaf book.

If, at the completion of an order by the foundry, there are still some castings missing, which are not accounted for, the shipping clerk makes out and turns in to the office a "still due" card. It is the same as Fig. 2, with the exception that it bears the words "Still Due" printed with a rubber stamp. This is entered in the "due card" column in the book and sent to the foundry.

How Rush Orders Are Handled

The "special rush" and "today" orders are taken care of in the following manner: When an order of this kind is received, a "sticker", Fig. 5, printed on red paper is placed upon the molder's card, in one corner; this notifies the foundry that this order should be cast that day, if possible, or if not, as soon thereafter as the nature of the work will allow; at the same time the name of the customer and order number are placed upon an "Out of Mill" slip, a sheet of plain paper being used for this purpose. When the cards are turned in at the end of the day, the clerk sorts out those carrying numbers similar to the ones that appear on the "Mill Slip" and compiles therefrom a production sheet as in Fig. 6. This goes to the shipper, who sees that the castings are cleaned and ready for early delivery the following morning. Any numbers remaining on the mill slip

Order No. | Quan. 12 | Date 1/26/13 | Moulder's Name and Number Kelly | Customer's Order Number 12507 | Order No. A 88365

For | No. in Flask 1 | Price Per Flask 20 | Prem. for Ex. Wk.

DESCRIPTION: Bearing Caps 5S-12

(STICKER SPACE)

DATE	MADE	DEF	SHIP'D	WEIGHT	DATE	MADE	DEF	SHIP'D	WEIGHT
2/4	2				2/28			2	30
2/5	2		2	30					
2/6	2		2	30					
2/7	2		2	30					
2/15	2								
2/16	2	2							
2/17	2		2	30					
2/8			2	30					

URGERS ISSUED: 2/3 | DUE CARDS ISSUED: Date 2/14, Quan. 2, Date 2/22, Quan.

SHIPPING DIRECTIONS

CUSTOMER'S NAME: Ajax Machine Co

CLASS: C

6606 1012

Fig. 1.

Order No. 88365 | Quan. 12 | Date 1/26/13 | Moulder's Name and Number Kelly | Customer's Order No. 12507

FOR Ajax | No. in Flask 1 | Price per Flask 20¢

6606 1012 DESCRIPTION: Bearing Caps 5S-12 | Premium for Ex. Wk.

REMARKS

Do not make more than ordered

DATE	Flasks	Total Castings	DATE	Flasks	Total Castings
2/4	2		Brought Forward		
2/5	2				
2/6	2				
2/7	2				
2/15	2				
2/17	2				

Fig. 2.

6065 61712

CUSTOMER Ajax Machine Co.

DATE ORDER	CUSTOMER ORDER No.	OUR ORDER No.	NAME	PATTERN NUMBER	No. WANTED	MOLDER	MADE	DEFECTIVE	SHIPPED	URGERS	SHOP PROMISES	DUE CARDS ISSUED
						20¢	2/4 2/5 2/6 2/7 2/15 2/16 2/17	2/16	2/15 2/6 2/7 2/8 2/17	2/3 R 2/4 SD	2/4 2/15	2/22
1/26/13	12507	88365	Bearing Cap	5S-12	12	Kelly	2 2 2 2 2 2 2	2	2 2 2 2 2			2

Fig. 3.

FDY. ORDER NO. 88365 | QUAN. 2 | DATE 2/16/13 | MOLDER'S NAME Kelly

FOR Ajax | NO. IN FLASK 1 | PRICE PER FLASK 20¢

DESCRIPTION: Bearing Cap 5S-12

DATE	NO. FLASK	TOTAL MOLDED
2/16	2	

6065 1212

Fig. 4.

IMPORTANT!

Give this order preference over all others not bearing this Red Tag. **Do Not Delay.**

Date.....

Signed.....

Fig. 5.

FIG. 1—SHIPPER'S ORDER

FIG. 2—MOLDER'S CARD

FIG. 3—COMPLETE LOOSE LEAF RECORD OF ORDERS FROM ONE CUSTOMER

FIG. 4—DEFECTIVE CARD FOR MOLDER

FIG. 5—RED STICKER FOR RUSH ORDER

PRODUCTION SHEET FOR Out of Mill orders DATE 1/26 1913

NAME OF PIECE	PATT. NUMBER	CUSTOMER'S ORDER No.	OUR ORDER No.	MADE	DEF.	DUE	SHIPPED Date	SHIPPED No.	SHIPPED WT.	MOLDER	REMARKS
Crosshead	*1024	88320	88316	2	1	1	1/27	1	18	Smith	
Guide	*1026	88321	88317	1			1/27	1	23	Carlson	

FIG. 6—SHIPPING CLERK'S SHEET FOR "SPECIAL RUSH" AND "TODAY" ORDERS

are transferred to the following day's sheet. If castings noted upon the shipper's sheet prove defective, he immediately makes out a defective card on which is placed a red sticker, Fig. 5, and every effort is made to make another casting at once. This card is also entered, like the others, in the defective column of the book.

Use Loose-Leaf Books

For convenience in handling, several loose-leaf books are used, arranged either alphabetically, by pattern symbol or by customer's name, so as to be most accessible for entering data and quick reference.

These books are carefully gone over each day; the progress of the various orders is noted and "Urgers" on those items which are lagging and require attention are made out and sent to the foundry for casting promise. If an order is not started within a previously determined period, varying with the customer and class of work, a "Not Started Urger", Fig. 7, is sent to the foundry, this fact being noted in the "urger column" of the book. The foundry foreman places thereon his promise to start the work and returns it to the office. This promise is entered in the "shop promise" column of the book and also on the carbon copy of the urger, the latter being used to follow up and ascertain whether the promise has been kept or not. This is accomplished by checking up the promises with the book each day.

The urgers themselves are then filed in a tray where they remain permanently, provided the shop promises are fulfilled. If not, they are taken out and again sent to the foundry as a reminder that the promise has not been kept and for a new promise.

In the case of an order which has been worked on, but not completed and upon which no castings have been made within a reasonable time, and also, in the case of castings which have been made but not shipped promptly, a "Still Due" urger, Fig. 8, is sent out to the foundry or shipping department. This follows the same routine as Fig. 6 and entries are made in the same way. These urgers are also used in cases where customers inquire about work not shipped and request a promise of delivery.

Machine Shop Methods Similar

The system for taking care of the work required for the machine shop of the company is practically the same as the one above outlined, with the exception that the order, Fig. 1, and molder's card, Fig. 2, are made out by the machine shop's pattern storage clerk and have two more manifold copies similar to Fig. 1. One of these is retained by the pattern storage department and the other is sent to the receiving department. These loose-leaf books, it will be seen, furnish a complete, accessible and accurate record of the status of the various orders going through the shop, for customer's reference or for the guidance of the executive in directing the work.

Decline in Implement Casting Demand

The decline in the demand for agricultural implement castings has been attributed to reduced exports on account of the European war and statistics recently available show that such exports for the 11 months ending May 31 have declined from $30,302,000 in 1914 to $9,450,000 in 1915. For the 11 months ending May 31, 1914, European Russia purchased $6,438,000 worth of agricultural implements from American manufacturers, whereas during the same period in 1915 the exports from this country to Russia amounted to only $83,000. The United States exports of agricultural implements, fiscal years, follow: 1893, $4,700,000; 1903, $21,000,000; 1913, $40,600,000, and 1915, $10,500,000.

DATE 2-3-13 TIME **URGER** 6081 61312

CUSTOMER	ORDER NO.	FDY. NO.	DESCRIPTION	NO. WANTED	WHEN
Ajax Mch Co			Bearing Cap 5S-12	12	

WILL BE CAST	WILL BE CLEANED	WILL BE SHIPPED
2/4/13 – Jones foreman		

DELIVERY PROMISED FOR | ENTERED ON SHIPPING SHEET

REMARKS Ordered 1/26/13 "Rush"

FIG. 7—NOT STARTED URGER

DATE 2-14-13 **STILL DUE URGER**

DESCRIPTION Bearing Caps 5S-12

CUSTOMER	ORDER No.	No. ORDERED	No. DUE
Ajax Mch Co		DATE 1/26 12	4

MOLDER	No. CAST	No. DEF.	No. SHD.	LAST CAST	LAST SHPD
Kelly	8	0	8	2/7	2/8

ENTERED S | REMARKS Pat ret'd for repairs Jones | WILL CAST 2/15 J.

FIG. 8—STILL DUE URGER

Operating the Cupola on a Scientific Basis

Discussion of the Importance of Measuring All Furnace Materials, Including the Pressure and Volume of Air

By David Townsend

EVEN today there are foundries run by men who brag that any old boiler shell can be set on end, bricked up and made into a good working cupola. Such foundrymen, when asked for their melting records, will give figures which are purely imaginative and nowhere near correct when determined from their actual practice. Foundries are running behind today because of their high percentage of bad castings and melting losses due to causes which could be definitely determined and corrected if the same amount of time, trouble and brains were put into the job as would be considered a fair expenditure for investigating and improving any other foundry operation.

No concerted action has as yet been taken by the various manufacturers of cupolas to standardize the variables which form the basis for a properly constructed machine, such as number, position and size of tuyeres, location and size of wind box, diameter of wind pipe as affected by distance between cupola and blower, shape of interior outline of the lining and many other minor points, which might be scientifically determined so they could be forever removed from the field of speculation or of personal opinion.

It is true that a start was made in this direction by the government in its testing laboratory at St. Louis, the results of which will be found in Bulletin No. 54 of the bureau of mines; but the investigation covered only a limited field, being based on the results obtained from a size of cupola, 27-inch, which is not generally used except by small jobbing shops or for occasional small or special heats in the larger plants.

If you will stop to consider the high standing and scientific reputation of the long line of investigators of the blast furnace you can appreciate possibilities of the foundry cupola which is but the child of the larger furnace and except in the degree of heat obtained, is just as susceptible to a proper treatment as was its larger parent. Millions have been spent by the builders and owners of blast furnaces in accurately determining every variable factor entering into the production of pig iron and auxiliary apparatus of the most expensive character has been added in order to obtain a high temperature of blast and a supply of air for combustion which will be free from moisture.

Although moisture-free air is undoubtedly too much of a refinement for the cupola which is operated only intermittently, it might be possible to use the waste gases to heat the incoming air; it also would pay to accurately determine the best shape for the interior lining and to adopt a standard for charging and operating which would produce fairly uniform results. The average foundryman is too much occupied in trying to make good castings at a low cost to give his time or intelligent investigation to discovering the exact conditions governing the running of his cupola or in making experiments to improve its operation.

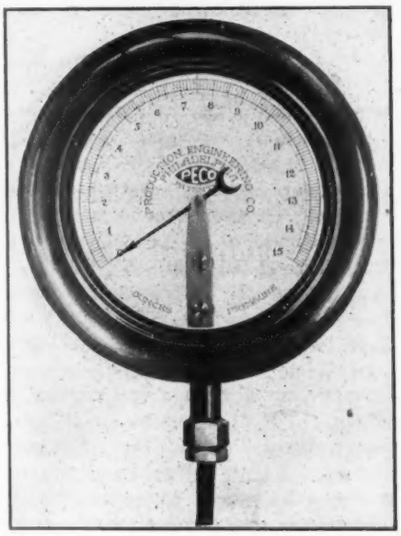


FIG. 1 — INSTRUMENT FOR MEASURING CUPOLA BLAST PRESSURE

Utilizing Waste Gases

In the blast furnace the waste gases are used to heat the blast to from 1,000 to 1,500 degrees Fahr., but in the cupola, all this valuable heat is practically wasted. Of course the waste gases from the cupola will have a very much lower temperature than those from the blast furnace, as the cupola temperature averages 2,800 degrees Fahr. at the melting zone as against 3,500 degrees in the blast furnace.

Numerous attempts have been made in the past to utilize the waste heat but there will have to be a radical departure from the present design of the cupola before it can be accomplished. In other words, the cupola must be converted into a miniature blast furnace with charging bell and means to maintain it under a uniform pressure, no matter how small. This obviously cannot be done on a small size cupola used for a few hours every day, but there should be no insuperable difficulty in accomplishing it in the large tonnage foundry.

Every melting operation requires the application of heat derived from some form of carbon, either gaseous, liquid or solid; the heat is evolved by the combination with the carbon, at a proper temperature, of sufficient oxygen to completely convert it into carbon dioxide for the purpose of obtaining the maximum benefit from the union in the shape of heat. Any apparatus which permits the consumption of fuel under conditions by which a portion of the possible heat may be lost is defective either in construction or in operation, and usually in both.

The importance of securing and maintaining a proper combination of carbon and oxygen is shown by the fact that carbon when burned completely to carbon dioxide gives off about 14,500 B. T. U. while carbon burned to carbon monoxide produces only 4,450 B. T. U., representing a direct loss of about 10,000 B. T. U. by imperfect combustion, and as both carbon monoxide and carbon dioxide are colorless, odorless gases, the loss may be taking place and be continuous without the knowledge of the operator, in fact nothing but an analysis of the gases will definitely fix the responsibility. In these days of automatic carbon dioxide recorders of low price there is no reason except habit which would prevent a study of the gases being produced by any series of conditions, which can then be controlled until a uniform method of operation has been evolved and has been reduced to a set of fixed rules. Every pound of pure carbon theo-

A paper read before the Philadelphia Foundrymen's Association. The author, David Townsend, is president of the Production Engineering Co., Philadelphia.

LENGTHS OF CHORDS FOR SEGMENTS OF DIFFERENT CIRCLES

By S. L. Cook

In laying out segments and templets, it is usually necessary to save as much stock as possible. For this purpose the following table is offered for the approval of careful patternmakers.

To use the table—Lay out the desired radius. Opposite the radius in the table for the customary number of segments, the chord will be found. Step the chord off on the arc already struck, connect with the center and segment is thus complete.

Radius, in.	3 segments to circle, in.	4 segments to circle, in.	5 segments to circle, in.	7 segments to circle, in.	8 segments to circle, in.
1	1 3/4	1 27/32	1 31/32	7/8	25/32
1 1/8	1 31/32	1 15/16	1 31/32	31/32	29/32
1 1/4	2 11/32	1 15/16	1 15/16	1 5/16	1 1/32
1 3/8	2 3/4	1 7/8	1 7/8	1 5/16	1 1/32
1 1/2	2 5/8	2 1/8	1 15/16	1 7/16	1 3/32
1 5/8	2 13/16	2 1/4	1 31/32	1 1/4	1 5/32
1 3/4	3 1/32	2 5/16	2 1/16	1 11/32	1 11/32
1 7/8	3 1/4	2 5/16	2 1/8	1 5/8	1 7/16
2	3 5/16	2 13/32	2 5/16	1 13/16	1 13/16
2 1/8	3 11/16	3	2 1/2	1 31/32	1 5/8
2 1/4	3 27/32	3 1/16	2 5/16	1 31/32	1 31/32
2 3/8	4 3/32	3 5/32	2 5/16	2 1/16	1 15/16
2 1/2	4 5/16	3 1/2	2 1/8	2 5/16	1 31/32
2 5/8	4 5/16	3 3/8	3 3/32	2 3/32	2 3/32
2 3/4	4 1/2	3 7/16	3 1/16	2 3/32	2 3/32
2 7/8	4 5/32	4 1/16	3 1/8	2 1/2	2 1/32
3	5 1/32	4 1/4	3 1/32	2 3/32	2 1/32
3 1/8	5 1/32	4 3/32	3 1/16	2 1/8	2 1/32
3 1/4	5 5/16	4 1/32	3 1/32	2 1/8	2 1/16
3 3/8	5 3/32	4 1/32	3 1/32	2 1/8	2 1/16
3 1/2	6 1/16	4 1/16	4 7/32	3 1/32	2 1/32
3 5/8	6 3/32	5 1/8	4 1/16	3 3/32	2 3/32
3 3/4	6 1/2	5 1/32	4 1/32	3 1/32	2 7/8
3 7/8	6 3/32	5 1/32	4 1/16	3 3/32	2 3/32
4	6 3/32	5 1/32	4 1/32	3 1/32	3 1/16
4 1/8	7 3/32	5 1/32	4 1/32	3 1/32	3 3/32
4 1/4	7 3/32	6 1/16	5	3 1/16	3 1/4
4 3/8	7 3/32	6 1/16	5 1/32	3 1/16	3 1/32
4 1/2	7 1/32	6 1/32	5 1/32	3 1/32	3 1/16
4 5/8	8 1/32	6 3/32	5 7/16	4 1/32	3 3/32
4 3/4	8 5/32	6 3/32	5 3/32	4 1/8	3 1/32

(Continued on Data Sheet No. 192.)

LENGTHS OF CHORDS FOR SEGMENTS OF DIFFERENT CIRCLES

By S. L. Cook

(Continued from Data Sheet No. 191.)

Radius, in.	3 segments to circle, in.	4 segments to circle, in.	5 segments to circle, in.	7 segments to circle, in.	8 segments to circle, in.
4 7/8	8 1/16	6 27/32	5 27/32	4 15/32	3 27/32
5	8 31/32	7 1/16	5 7/8	4 11/32	3 27/32
5 1/8	8 7/8	7 1/4	6 3/32	4 23/32	3 29/32
5 1/4	9 3/32	7 7/32	6 11/32	4 7/16	4 1/16
5 3/8	9 1/16	7 11/32	6 1/16	4 13/32	4 7/32
5 1/2	9 11/32	7 23/32	6 13/32	4 13/32	4 13/32
5 5/8	9 3/4	7 31/32	6 29/32	4 7/8	4 1/16
5 3/4	9 31/32	8 1/8	6 31/32	4 29/32	4 11/32
5 7/8	10 11/32	8 1/16	6 29/32	5 3/32	4 1/2
6	10 23/32	8 3/32	7 1/16	5 1/32	4 13/32
6 1/8	10 29/32	8 31/32	7 13/32	5 5/16	4 11/16
6 1/4	10 23/32	8 23/32	7 11/32	5 7/32	4 25/32
6 3/8	11 1/16	9 1/32	7 1/2	5 17/32	4 7/8
6 1/2	11 13/32	9 1/16	7 21/32	5 21/32	4 31/32
6 5/8	11 15/32	9 3/16	7 25/32	5 3/4	5 1/16
6 3/4	11 11/16	9 9/32	7 7/8	5 25/32	5 11/32
6 7/8	11 29/32	9 23/32	8 1/16	5 31/32	5 11/32
7	12 1/8	9 29/32	8 1/32	6 1/16	5 13/32
7 1/8	12 11/32	10 1/16	8 3/8	6 1/8	5 13/32
7 1/4	12 1/8	10 1/4	8 13/32	6 11/32	5 13/32
7 3/8	12 15/32	10 1/8	8 11/32	6 13/32	5 11/32
7 1/2	12 29/32	10 31/32	8 1/2	6 23/32	5 23/32
7 5/8	13 11/32	10 25/32	8 15/32	6 25/32	5 27/32
7 3/4	13 27/32	10 31/32	9 7/32	6 29/32	5 15/16
7 7/8	13 31/32	11 1/16	9 1/4	6 31/32	6 1/32
8	13 25/32	11 1/8	9 1/32	6 15/16	6 1/8
8 1/8	14 1/16	11 11/32	9 11/32	7 1/8	6 1/8
8 1/4	14 1/32	11 13/32	9 13/32	7 1/16	6 1/8
8 3/8	14 1/2	11 27/32	9 23/32	7 11/32	6 13/32
8 1/2	14 23/32	12 1/16	10	7 3/8	6 1/2
8 5/8	14 15/16	12 11/32	10 1/16	7 11/32	6 13/32
8 3/4	15 5/32	12 3/8	10 5/32	7 15/32	6 17/32
8 7/8	15 3/8	12 25/32	10 7/16	7 11/16	6 21/32
9	15 19/32	12 27/32	10 27/32	7 13/16	6 25/32
9 1/8	15 13/16	12 29/32	10 31/32	7 29/32	6 29/32
9 1/4	16 1/16	13 1/16	10 7/8	8 5/32	7 1/16
9 3/8	16 11/32	13 7/32	11 1/16	8 1/16	7 1/32
9 1/2	16 29/32	13 7/16	11 1/32	8 1/4	7 11/32
9 5/8	16 13/32	13 29/32	11 5/16	8 11/32	7 13/32
9 3/4	16 27/32	13 29/32	11 15/32	8 15/32	7 15/32
9 7/8	17 1/16	13 31/32	11 31/32	8 5/16	7 5/16
10	17 1/32	14 1/16	11 3/4	8 13/32	7 11/32
10 1/8	17 1/32	14 1/16	11 29/32	8 15/32	7 3/4
10 1/4	17 3/4	14 1/2	12 1/16	8 27/32	7 23/32
10 3/8	17 31/32	14 13/32	12 11/32	9	7 25/32
10 1/2	18 1/16	14 15/32	12 11/32	9 1/16	8 1/32
10 5/8	18 13/32	15 1/32	12 11/32	9 3/32	8 1/8
10 3/4	18 5/8	15 1/32	12 11/32	9 11/32	8 1/32
10 7/8	18 27/32	15 3/8	12 25/32	9 7/16	8 11/32
11	19 1/16	15 7/16	12 15/16	9 25/32	8 27/32

THE FOUNDRY DATA SHEET, AUGUST, 1915

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note-book form.

retically requires 2.67 pounds of oxygen or 11.52 pounds of air for its complete combustion. Unfortunately air contains only about 23 per cent of oxygen, the balance being largely nitrogen which is an inert gas, supplied by nature to prevent a too rapid combustion.

An average 72-hour Pennsylvania foundry coke has about the following analysis:

	Per Cent.
Moisture	0.50
Volatile Combustible	0.60
Fixed Carbon	87.75
Ash	10.35
Sulphur	0.80
	100.00

In order to burn this coke completely we must supply sufficient air to furnish the necessary amount of oxygen. That is to say, if we assume for the sake of illustration only that the cupola is running on a 10 to 1 fuel ratio; for each 2,000 pounds of iron we will use 200 pounds of coke of which 175.5 pounds will be carbon requiring 2,022 pounds of air for its complete combustion. Air is usually measured in cubic feet, but as the weight varies with the temperature, moisture, etc., we may assume that it will be supplied at an average temperature of 70 degrees Fahr. in which case the coke will require 154.7 cubic feet of free air per pound of carbon or a total of 27,150 cubic feet, which is not far from the 30,000 cubic feet of free air usually considered necessary to melt one ton of iron.

An admirable discussion of the variables entering into the melting of iron in a cupola may be found in Bulletin No. 3 issued by the bureau of mines, but particular attention should be called to the fact that even if the proper combination of air and fuel may have taken place in the melting zone, actual heat might be lost if conditions are such that the carbon dioxide is reacted on in passing up through the incandescent coke and reduced to carbon monoxide; the latter gas may be detected by the flame burning in the upper part of the cupola. This reaction takes up the heat which it had previously given off, and the result is a very considerable drop in temperature, thus robbing the descending iron of the amount of pre-heating it would otherwise get before sinking into the melting zone.

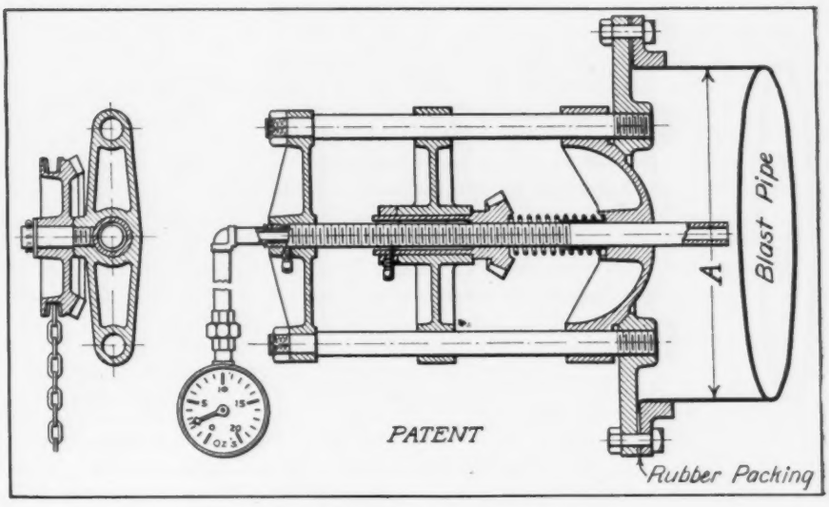


FIG. 3—AIR REGULATING RELIEF VALVE

Importance of Proper Air Distribution

The proper distribution of the air entering the cupola and its union with the fuel will explain and cure many ills such as burnt, cold and spongy iron, which are the result, not so much of the quality of the metal charged, as of errors in melting and manipulation, which may be classified and corrected. Considerable care generally is taken to measure and record the amount of iron and coke which are put into the cupola, but few foundrymen weigh or measure the air that is being used. That this is just as important an item as any other cannot be disputed when it is remembered that of the 27,150 cubic feet of air mentioned previously about 77 per cent is nitrogen, which must be heated to the temperature of the furnace and then discharged into the atmosphere without having done any work, unless it is utilized to preheat the incoming air, as is done in the blast furnace.

In furnishing air to the cupola, the most important condition is to have a continuous supply at a constant pressure and this can be obtained by having an air tight chamber of sufficient size between the cupola and the source of air supply to equalize all pulsations, belt slippage, etc., which will otherwise affect conditions for proper working. The present wind box supplied by the cupola builder does not usually give a sufficient volume to properly equalize the pressure.

It is not only important to get the right amount of air for complete combustion into the cupola, but equally so, not to get too much, as a surplus of various amounts has a decided cooling effect. This is indicated by Fig. 2.

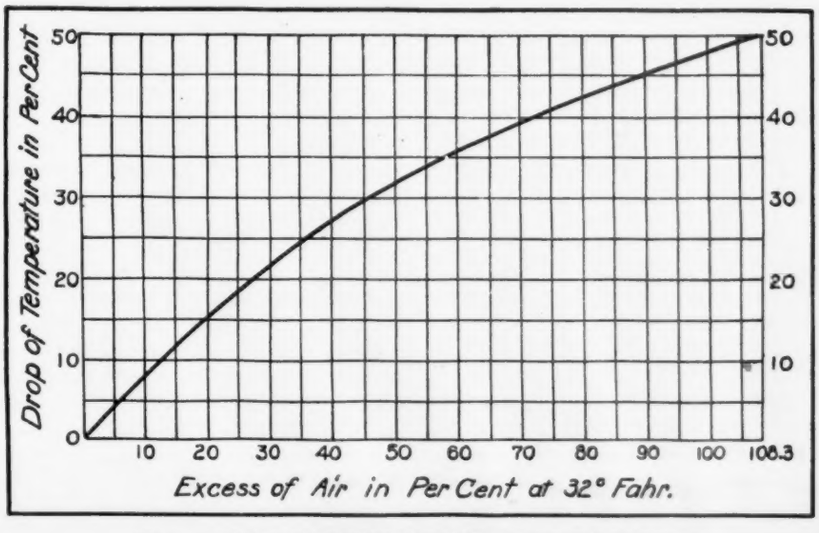


FIG. 2—CURVE SHOWING INFLUENCE OF EXCESS AIR ON FURNACE TEMPERATURE

Depends on Variable Factors

The amount of air necessary for the complete combustion of the fuel put into a cupola depends upon a number of variables, of which the carbon content of the fuel, pressure and distribution of the air, and constancy of supply of both fuel and air are the principal items.

Most of the present instruments for measuring small blast pressures are too limited in range for quick observation by the melter or foreman

and, with one or two exceptions, those for determining the volume of air are too complicated to be of any value for every-day work, being designed for use by a specially trained assistant or engineer. The direct mercury pressure gages having a range up to 16 ounces, have a total movement of only about 2 inches or ⅛-inch reading to an ounce of pressure, and while the water U-tube has a length of 27¾ inches for the same range of pressure, it takes up considerable space and is liable to be broken; in addition to which a scale must be furnished for reading differences in heights between the two legs.

The company with which the writer is associated has designed and patented a low pressure circular gage ranging from 0 to 16 ounces pressure, the readings being indicated on a circular dial, similar to all steam gages and having divisions as fine as 1/10-ounce which are easily readable, the division for one ounce being ⅞-inch in length. The same gage when filled with a special liquid will read from 0 to 2 inches of water for either pressure or vacuum, the divisions being as fine as 1/500-inch of water. This gage, shown in Fig. 1, has almost the appearance of a steam gage of similar size. It is 7 inches in diameter x 3¾ inches deep. It is constructed on the float principle, but has been so made that the liquid can be shipped in the gage without any danger of spilling, being entirely self-contained. It has several other features, the most important being means for bringing the hand to the zero point on the scale whenever necessary, and a three way plug cock which prevents any excessive pressure from being suddenly thrown into the gage which might break the glass or spill some of the liquid. Provision has been made to limit the capacity of the gage to the length of the scale, as any additional pressure automatically closes the opening into the liquid chamber. A means has also been devised by which it is believed the scale readings are made accurate throughout the whole scale length.

Measuring the Volume of Air

It is much more difficult, however, to determine the volume of air going into the cupola at any given time. This is usually done by means of a Pitot tube, which consists of two copper tubes of small diameter, having their ends bent over at right angles and tapered, the two tubes being fastened together so that the bent ends point in opposite directions. The free ends of the tubes are attached to the draft or pressure gages in such a manner that the readings will represent the pressure in one tube and the suction in the other, the difference being a measure of the velocity of the air in the blast pipe and from which the volume of air passing may be determined. The position of the two bent tubes in the blast pipe gives different readings and an average must be obtained to get scientific results.

On account of pressures produced in the two Pitot tubes being very small, it is usually necessary to use two inclined manometers reading in inches of water and use the differences for making the velocity calculations. This introduces an element of uncertainty on account of there being two instruments to calibrate and read simultaneously. A differential blast meter, however, has been devised by Charles J. Clark, Chicago, which is said to be satisfactory.

Gage Simplifies Calculations

The low pressure and vacuum gage reading to one or two inches of water and down to 1/1000-inch if required as built by the Production Engineering Co., gives this difference of pressures between the two Pitot tubes directly on the scale and requires only a simple calculation to determine the volume of air passing through any given size of blast pipe, there being only one instrument and one reading to be made.

A desirable form of volume meter would be one which would be entirely within the blast pipe itself, and through which all the air passing from the blower or fan to cupola must go, there being no average to compute and no loss due to leakage or friction. The Production Engineering Co. has designed and has now in the patent office a meter which is expected to fulfill all the requirements and has in addition a scale from which the volume of air passing at any given time may be read off directly and without calculation.

For the good results a still further piece of apparatus should be provided, namely, a relief valve which can be set to maintain any pressure desired and which will open automatically if an excessive pressure is generated.

The usual practice with cupola tenders when they want to slack down is to reduce the speed of the blower or in some instances shut it down altogether. This of course applies more particularly to positive pressure blowers, as fans will take care of themselves if the blast pipe is closed off. Blowers, however, should not be stopped after being started, but should be relieved and the melting rate regulated by means of a relief valve on the blast pipe line and close to the cupola wind box.

A special air regulating blast valve has been designed and patented for this purpose, which, it is said, can be applied to any size blast pipe and will operate in any position, being adjustable to any pressure and having an automatic relief device for the protection of the blower and the blast pipe. This valve can be set to open at any pressure desired or can be left open, instead of shutting off the blower or fan if for any reason it is desired to stop or slacken the rate of melting. By its use in connection with the pressure gage any desired pressure may be obtained and maintained to produce the rate of melting desired or consistent with that generally considered good practice. Any scientific investigation which embraces only one end of the melting operation would be incomplete. In order to know whether we have succeeded in obtaining the best results possible by a control of the pressure and amount of the blast and its proper distribution in the cupola, we must also know if it has completely performed its intended function during the melting operation. This can be ascertained by an analysis of the waste gases in the stack above the charging door, taken in conjunction with pyrometric temperature readings at several points in the cupola and stack.

In order to secure a proper gas sample from the stack, the sampling tube should go all the way across the inside of the lining and be furnished with a number of equidistant holes to assure a proper average. Care also should be taken to temporarily shut off any air which may be induced through the charging door, by closing it tightly with a temporary solid shield and allowing the gases to flow through the tube for a short time before collecting the sample. A determination of the carbon dioxide, carbon monoxide and oxygen will indicate what is taking place in the melting and heating zones and when taken in conjunction with temperature readings, the necessary remedies may be applied to correct improper methods of operation.

Radiators Lack Strength

By W. J. Keep

Question:—We manufacture sectional tube steam and water boilers, which are being tested at a water pressure of from 55 to 65 pounds. Frequently the entire side of a casting is blown out at this pressure. However, we desire to make these castings of sufficient strength to withstand a pressure of 100 pounds. The metal thickness is 5/16-inch and the

sections range in weight from 185 to 800 pounds. The irons in our yard, from which we have to make mixtures, follow:

Low phosphorus: Silicon, 1.27 per cent; sulphur, 0.022 per cent; phosphorus, 0.175 per cent, and manganese, 1.58 per cent.

Virginia: Silicon, 2.66 per cent; sulphur, 0.032 per cent; phosphorus, 0.590 per cent, and manganese, 1.06 per cent.

High silicon: Silicon, 6.06 per cent; sulphur, 0.022 per cent; phosphorus, 0.420 per cent, and manganese, 0.33 per cent.

We would like a mixture satisfactory for our use that will withstand 100 pounds pressure.

Answer:—This is not a question of iron mixture inasmuch as with the irons you describe you could not possibly make a poor mixture for your work. The silicon for your castings should be calculated at about 2.25 per cent, unless you find that you can machine them with a content of 2 per cent. Also you should make changes in your patterns so that the castings can be subjected to 100 pounds pressure. Also see to it that the cores are so made that they leave no sharp corners on the inside of the castings. I am of the opinion that if you would examine your cores, all of the edges will be found to be sharp. These should be rounded off. Be careful in the selection of scrap for your mixtures and do not use any burnt iron.

An Electrically-Driven, Portable Sand Riddle

A PORTABLE, gyro-reciprocating riddle built like a wheelbarrow is manufactured by the Champion Foundry Machinery Co., Chicago. As shown in Fig. 1, the machine is equipped with three legs, the third leg terminating in a loose wheel, the axle of which operates in a cam slot. When it is desired to move the riddle, the leg is lifted and the wheel drops into place of its own weight, so as to enter the cam and bear the weight of the machine. As illustrated in Fig. 2, the arms which support the riddle shaker are used also as wheelbarrow handles. It is claimed that the three legs of the machine, resting solidly on the floor at divergent angles, insure freedom from shifting due to vibration from the motor. The riddle is operated by a ¼-horsepower motor using current from any lamp socket. Power is transmitted by a steel worm and cast iron gear to a one-piece steel crank connected to the steel arm directly over the motor. This arm works on a simple roller bearing, consisting of two hardened steel runways between which is a 1-inch steel ball. A standard 18-inch hand riddle is held rigidly in a steel frame without the use of clamps. The entire machine is made of metal.

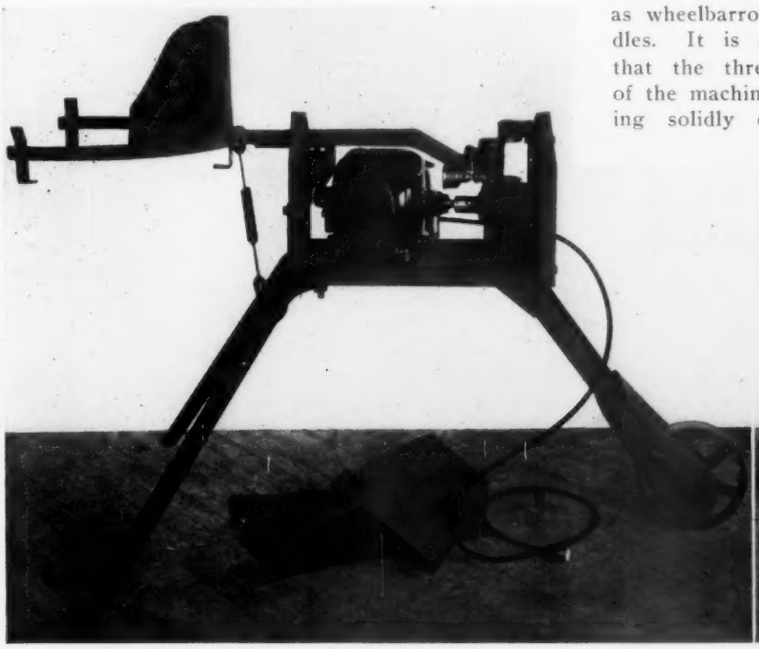


FIG. 1—PORTABLE GYRO-RECIPROCATING RIDDLE WITH SAND-PROOF COVERS REMOVED

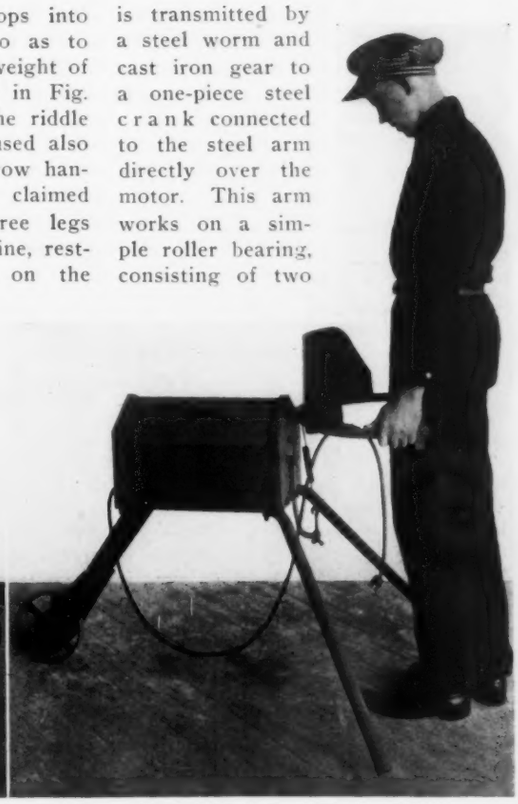


FIG. 2—PORTABLE RIDDLE, SHOWING METHOD OF MOVING IT LIKE A WHEELBARROW

Tribute to Memory of Thomas D. West

To the Editor:

Will you accord the writer the privilege of adding a word to the appreciation of the late Thomas D. West published in the July issue of *The Foundry*?

In 1875, or 40 years ago, the writer was foreman of Younglove Massey & Co.'s foundry at Cleveland, and about that time a life-long acquaintanceship began with Mr. West or "Tommy" West as he was familiarly called by those well acquainted with him.

At that time Mr. West was working in the Eclipse Iron Works, Cleveland, Chambers and Macbeth being proprietors, and if memory serves correctly John Stoney was foreman of the shop. It was at that time that Mr. West made his mark as a molder of the highest grade by turning out 80 locomotive cylinders without losing one. This was considered an achievement in those days because the specifications for the cylinders were so exacting that the least flaw in one of them was enough to consign it to the scrap pile.

The valuable works on foundry practice written by Mr. West represent and record for the most part his own prac-

(*Continued on page* 331)

THE FOUNDRY

A monthly journal devoted to all branches of the foundry trade

Published by

The Penton Publishing Co.

Penton Building, CLEVELAND

BRANCH OFFICES

BIRMINGHAM, ENG.	Prince's Chambers
CHICAGO	1521 Lytton Bldg.
CINCINNATI	312 Johnston Bldg.
NEW YORK	507 West Street Bldg.
PHILADELPHIA	326 Real Estate Trust Bldg.
PITTSBURGH	2148-49 Oliver Bldg.
WASHINGTON, D. C.	206 Corcoran Bldg.

SUBSCRIPTION

United States and Mexico	$1.00 a year
Canada	$1.50 a year
Great Britain and other Foreign Countries	Eight Shillings
Single Copies	15 cents

Copies published three months or more previous to date of current issue, 25 cents each.

ADVERTISING

All communications relating to advertising copy, discontinuances, etc., must be received on the 10th of the month preceding date of publication.

Entered at the Post Office at Cleveland as Second Class Matter

Copyright, 1915, by the Penton Publishing Co.

Contents

How to Make Automobile Engine Castings 291
Strong Cast Iron 294
New York State Rules Governing Casting Plants 295
Success and Failure in the Foundry 297
Cast vs. Forged Shrapnel Casing 298
Shop Management and What It Means 299
Emery Tool Grinder for Patternmakers 300
Steel Casting Concern Expands 300
Miscellaneous Stands for Use in the Foundry 301
A Place for Pattern Plates 303
Charcoal as Fuel for Cupola Melting 303
Chill and Shrinkage of Cast Iron 304
Other Solutions of Foundry Difficulties 304
Walker Wedge Testing Machine 305
Electric Brass Melting Furnace 305
Training Embryo Foundry Leaders in School 306
Bridging of a Cupola 310
The Control of Sulphur 310
Install Blystone Mixers 310
Fatigue of Copper Alloys 311
Classification of Old Metals 312
Recovery of Secondary Metals in 1914 313
Trolley Wheel Difficulties 315
Composition of Manganese Bronze 315
Modern Practice in Electrical Arc Welding 316
Brazing Outfit for Narrow Band Saws 317
Wants Soft Iron 318
A Practical Follow-Up System for the Foundry 319
Decline in Implement Casting Demand 321
Operating the Cupola on a Scientific Basis 322
Radiators Lack Strength 324
An Electrically-Driven, Portable Sand Riddle 325
Tribute to Memory of Thomas D. West 325
The Atlantic City Meeting 326
Trade Outlook 326
Reclaiming Metals from Cinder 327
Improved Oil Switch 328
Lubrication of Hanna Sifters 328
A New Metal Band Saw 328
Compressed Air Hose Coupling 329
Portable Grinder 329
Ingersoll-Rand Close Quarter Drill 329
Lincoln Arc Welder 330
Cooper Squeezer Molding Machine 330
Personal 331
Cloth Screen Dust Arrester 331
General Industrial Notes 332

The Atlantic City Meeting

WITH an enrollment of approximately 1,000, the American Foundrymen's Association, in point of membership, now ranks with the leading technical societies of the world. Less than 20 years ago, a handful of casting manufacturers met in Philadelphia for the purpose of forming a national body to include the various foundrymen's locals which had sprung up in several industrial centers. From this modest beginning the association has grown in numerical strength, until today it is the world's leading organization of foundrymen. The American Institute of Metals, originally the brass section of the American Foundrymen's Association, now has a membership of nearly 300, and since both societies hold simultaneous annual meetings, the convention this year at Atlantic City should bring out the largest attendance in the history of these organizations. Roughly estimated, approximately one-fourth of the foundries of the United States are represented by membership in the two associations, but in view of the magnificent work that is being done to improve the art of casting metals, every plant engaged in this line of work should support this great cause which directly benefits every phase of the industry. Almost every advanced step that has been taken in foundry practice in the last two decades can be traced to the deliberations of these two great technical societies and the results of their research and the solutions of problems have been magnanimously tendered to the entire trade. The papers and committee reports that will be presented this year will mark distinct forward strides in the industry. Every phase of casting work will be discussed, including gray iron, malleable, steel and brass. In the preparation and adoption of standards, the American Foundrymen's Association now is taking a more profound interest than at any time since its organization, and its efforts in this line of endeavor are receiving well-deserved recognition by other technical bodies. The report of the committee on costs should attract wide attention. A simple system will be presented which can be applied in the accounting department of every casting plant. It is stripped of the infinite detail that only too frequently makes cost methods involved, and having been prepared largely by practical foundrymen who know, by experience, the needs of their craft, it can be adopted safely as the foundation principle upon which can be reared a system that will meet the most exacting requirements. Concurrent with the annual meeting of the two technical societies, the customary exhibit of foundry supplies and equipment will be held. Notwithstanding the fact that practically two months must elapse before this event, more manufacturers have already closed for space than ever before. This indicates that the exhibition feature will be on a larger scale than heretofore.

Trade Outlook

EVERY branch of the foundry industry is showing a distinct improvement and the melt is being increased. Prices, in some lines, have been advanced slightly, and there is every indication that the trade is approaching a normal condition. Pig iron is firm at the following quotations: No. 2, Pittsburgh, $13.70; Cleveland, $13.50; Chicago, $13; Philadelphia, $14.25, and Birmingham, $9.75. Malleable, $13, Chicago; $12.50, Buffalo, and $15, Philadelphia. Basic, Pittsburgh, $13.95, and eastern Pennsylvania furnaces, $13.75.

Equipment for the Foundry and Pattern Shop

Reclaiming Metals From Cinder—Improved Oil Switch—Lubrication of Hanna Sifters—New Metal Band Saw—Hose Coupling—Portable Grinder—Close Quarter Drill—Arc Welder—Squeezer—Dust Arrester

THE METALS used in brass and other non-ferrous foundries are relatively valuable and for this reason a great deal of study has been given to the development of effective apparatus for reclaiming the metallic contents of furnace cinder or slag. Among the various foundry engineers who have contributed to the solution of this problem is Chas. A. Dreisbach, inventor of the New Haven sand blast barrel, who has designed a new combination crusher and mill which is said to effect a separation of cinder and metal in an unusually satisfactory and economical manner. The details of this crusher, which is being marketed by the Standard Equipment Co., New Haven, Conn., are shown in the accompanying illustrations.

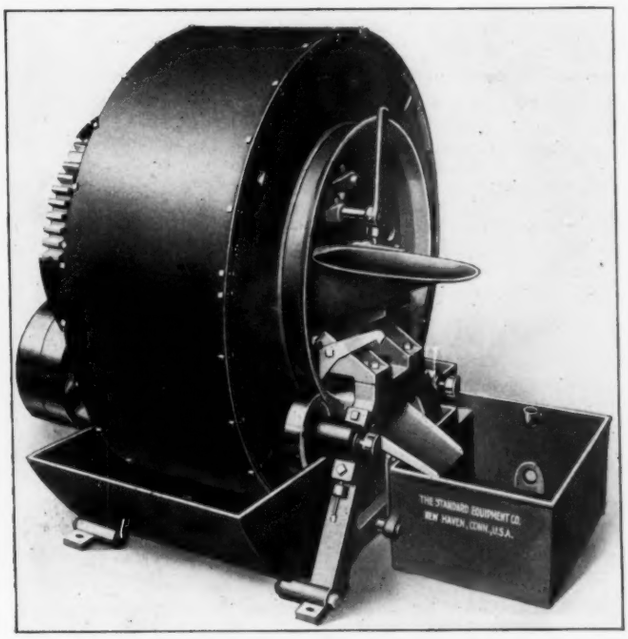


FIG. 1—FRONT VIEW OF CINDER MILL SHOWING HOPPER IN POSITION FOR FEEDING

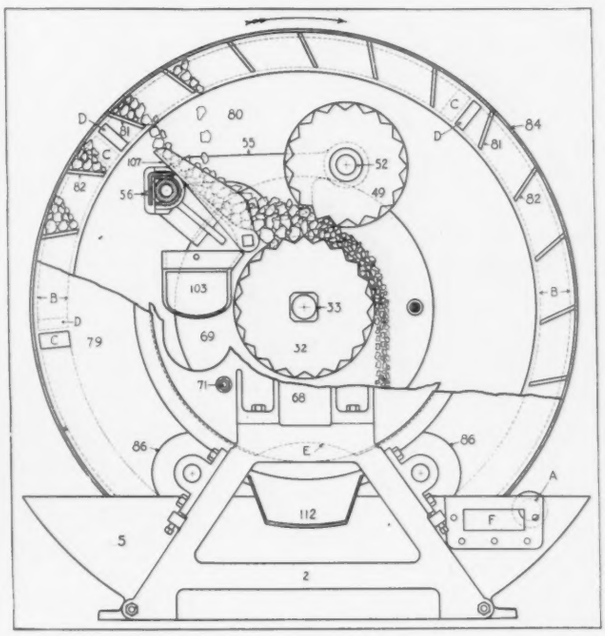


FIG. 2—SECTIONAL VIEW SHOWING ARRANGEMENT OF CRUSHING MECHANISM

The crusher requires only three horsepower, whether running on the wet or dry process, to handle about 1,000 pounds of cinder per hour. When using the wet process, which is recommended, after the mill has been filled with about 200 gallons of water, it will operate without repeated, complete refillings, it being necessary merely to occasionally replenish some of the water which is taken out with the tailings. It is stated that the mill will crush and separate cinders as fast as a man can ordinarily shovel them into the hopper and that less than 1 per cent of metal is wasted in the final dross or mud delivered by the machine.

Details of Construction

Fig. 1 shows a front view of the machine with the charging hopper in position for feeding. When cleaned metal is to be discharged, the roll-feeding lever, shown just above the hopper, is thrown to the right and the hopper is lowered to a suitable position for unloading.

Fig. 2 shows the construction of the mill in considerable detail, the upper half of the front ring and front head being cut away to show the arrangement of the crushing rolls. The center roll, *32*, is driven by a square shaft, *33*, and the idler roll, *49*, is mounted on shaft, *52*, and held in place with a yoke, *55*. It is free to turn by friction from the center roll. The yoke is hinged to the frame, *56*, which is cast on the front and back heads, *68* and *69*. The idler roll, *49*, is self-adjusting and large pieces of metal may be passed through the mill without stalling it. The rolls do not come in actual contact with the drum.

The conveying drum is driven from the center shaft, *33*, by a heavy chain belt running over a cast steel pinion. As the material is fed through the charging hopper, it is conveyed by means of buckets, *81* and *82*, to the controller chute, *107*, from which it passes into the rolls. From the latter it falls to the bottom of the conveyor drum which again raises it and deposits it in the feeding chute. This operation is repeated until the material is crushed fine enough to permit it to flow through the opening *E* into the settling tank.

It is claimed that cinder can be fed into the mill continually until the drum contains from 300 to 450 pounds of metal, when the first section of the settling tank should be cleaned out and the mill allowed to run about 1½ hours to wash out all the dross, or dirt, leaving clean metal in the drum. The mud that flows off during the washing operation should be run through the mill again with the next lot of cinders.

When the control lever, mentioned previously, is shifted to the right, the charging hopper is dropped and the

controller chute, *107*, is shifted into position to discharge the metal carried up by the buckets into the chute, *103*, which delivers it to the receiving box.

The water tank, *5*, and the settling tank should be filled with water up to the overflow outlet *A* before the mill is started. As the drum revolves, the water fills the cored chamber *B* through the opening *C* on the outside and empties into the bottom of the drum through a similar opening *D* on the inside. The water entering at the bottom of the drum, therefore is forced up through the metal and cinder, pushing out the crushed cinder through the opening *E*. The overflow passes through the chute, *112*, into the settling tank. The mud settles in the tank and the water flows back through the opening *F* into the water tank. Therefore the same water is used over and over again. The water in tank, *5*, should always be level with the overflow *A*. It will be noted that no pump is required to keep the water in proper circulation. The mill weighs 4,800 pounds and as stated previously, requires a 3-horsepower motor. The center roll operates at 36 revolutions per minute and the conveyor drum at four revolutions per minute. The crushing rolls are made of chilled iron with herringbone corrugations. The center crushing roll is 14 inches in diameter and 13½ inches in length and the idler crushing roll is 12 inches in diameter and 13½ inches in length. The water is circulated through the machine at the rate of 30 gallons per minute.

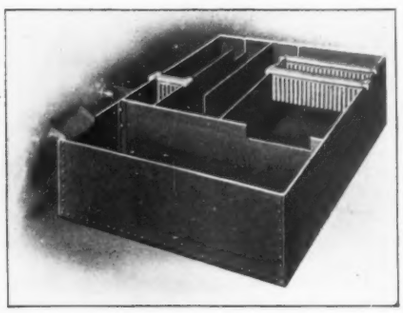


FIG. 3—STANDARD SETTLING TANK

Improved Oil Switch

An improved type of oil switch for use in controlling and protecting induction motors up to 2,500 volts and 300 amperes, has been developed by the General Electric Co., Schenectady, N. Y. It can be mounted on a wall, post or other vertical flat surface, or on the machine. The switch is made in both non-automatic and automatic forms. The former type is used to start and stop the motor, and the latter to cut-off current from the motor automatically on the occurrence of an excessive overload.

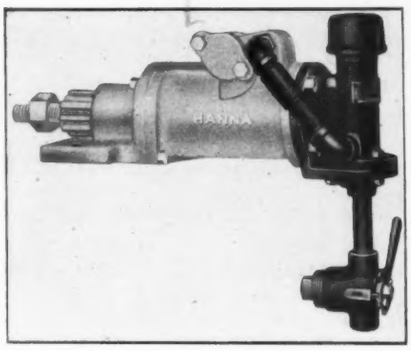


FIG. 1—SUCTION OILER AND EJECTING THROTTLE VALVE WITH WHICH HANNA SAND SIFTERS ARE EQUIPPED

Through a recent improvement in the design of the mechanism, a low-voltage trip can be added to the automatic switch. A low-voltage trip or a series-overload trip, or both, can be added to the non-automatic switch. Both means of tripping are mounted inside the switch cover.

Up to 550 volts, excepting 110-volt, 60-cycle circuits where the trip coil is sufficient, an auto-transformer is used in place of the resistance previously required in series with the low voltage tripping coil. This transformer has taps to which proper connections can be made for the operating voltage. For 2,200-volt circuits, a new type of voltage transformer replaces the transformer and series resistance previously employed. Its use is said to make the watt loss in the low-voltage device negligible.

Lubrication of Hanna Sifters

The sand sifting machines built by the Hanna Engineering Works, Chicago, have been further improved by the addition of a suction oiler and ejecting throttle valve, as illustrated in Fig. 1.

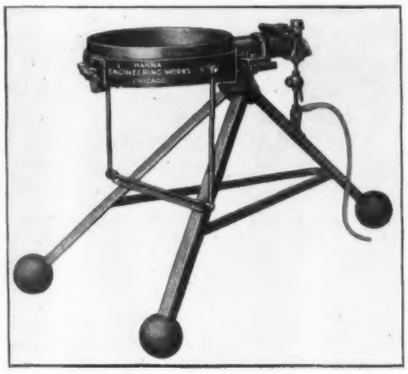
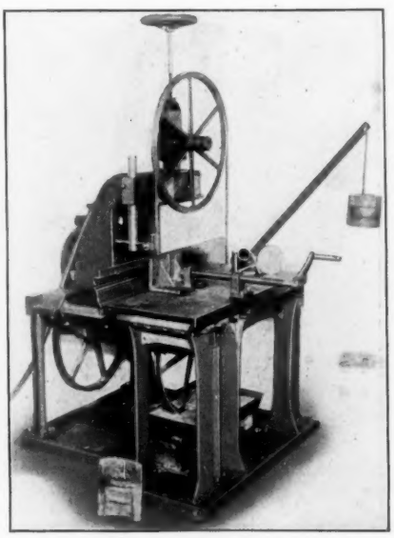


FIG. 2—SMALL TRIPOD SAND SIFTING MACHINE EQUIPPED WITH SUCTION OILER AND EJECTING THROTTLE VALVE

The oiler is automatic, the suction action becoming operative with the admission of the compressed air and ceasing when the air is shut off. A chamber containing an absorbent is constantly saturated with oil from a storage chamber surrounding it. Air passing through the oiler becomes sufficiently charged to properly lubricate all surfaces with which it subsequently comes in contact, prolonging the life of the equipment and increasing its efficiency.

The ejecting throttle valve is so arranged that it is impossible to admit air to the machine without ejecting, through a port arranged for that purpose, any sand which is picked up by the hose while it is disconnected and scale from the inside of the pipe line, grit or other foreign matter that may be present in the air line. The foreign substances are ejected automatically during the period of moving from closed to open position and without the loss of any more air than necessary to clean out the accumulation of the material in the hose. The valve eliminates damage to the working parts of the machine resulting from foreign matter entering the loose end of the hose which is connected to the machine without first blowing out the foreign particles. The small tripod sand sifting machine equipped with the suction oiler and ejecting throttle valve is shown in Fig. 2.



BAND SAW FOR CUTTING METAL

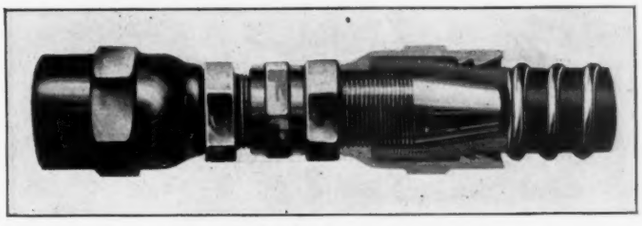
A New Metal Band Saw

A new metal band saw has been placed on the market by H. C. Williamson, Chicago,. It is designed to cut round or square bars, or I-beams up to 8 inches. Tubing and light material also can be handled on this machine, the back of which is removable, presenting a flat table for special work. This table is stationary, so that

heavy bars need not be moved to the blade. The frame which carries the wheels, saw and driving mechanism, slides on a track, as shown in the accompanying illustration, and may be operated by hand or by an automatic gravity feed. The saw guide is located so as to facilitate adjustment. The saw pressure is varied by hanging weights on a lever. When motor drive is used, the motor is mounted on the frame, which is self contained. The blade is tightened by a hand wheel. One operator, it is said, can run several machines at the same time. The table is 26 inches from the floor, facilitating the handling of heavy material. The saw will not handle pieces more than 20 inches long.

Compressed Air Hose Coupling

A new coupling is being manufactured by the National Hose Coupling Co., Peoples Gas building, Chicago, for use on hose carrying compressed air, steam or water, and may be attached, it is said, without clamps, straps or special fastening tools. The sockets are malleable, all other parts being steel.

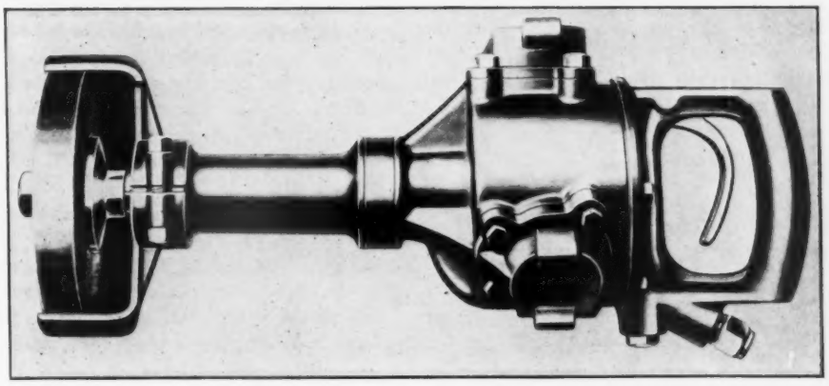


HOSE COUPLING FOR FOUNDRY USE

The socket is corrugated internally, as shown in the accompanying illustration, providing a positive grip when the hose is expanded, the steel taper expander forcing the hose outward into position as it is screwed into place. The hose enters the socket readily and may be cut and recoupled as often as required. Absence of projections on the exterior prevents catching on sharp corners as the hose is dragged along the floor or over material. No attempt is made to contract the outside of the hose, all stress being applied from the inside. The edge of the socket and end of the expander are rounded to prevent injury to the hose, no special attachments being required. The internal diameter of the hose is not narrowed by the device. The coupling is designed for use in foundries and other industrial plants.

A Portable Grinder

A portable pneumatic grinding machine recently has been introduced by the Ingersoll-Rand Co., New York. This tool has a number of novel features and was designed with special reference to simplicity and accessibility.



PORTABLE PNEUMATIC GRINDING MACHINE

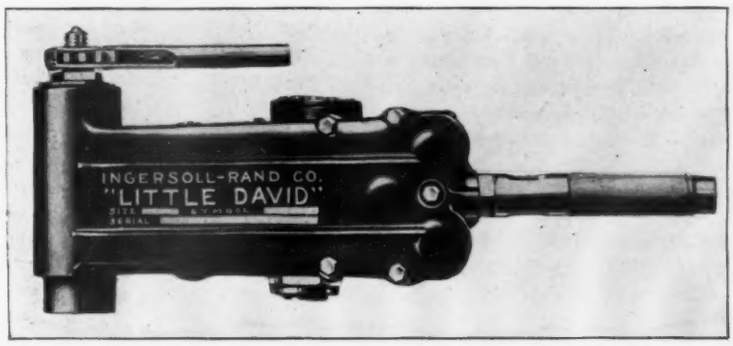
The motor is the three-cylinder type. The connecting rods are of one-piece construction, fitted to the crank shaft on roller bearings. The crank shaft and spindle are a one-piece forging, which runs on a triple ball bearing, one bearing being used in the front end of the main body of the casing and two bearings on the end of the spindle. All parts are enclosed in a dustproof case and operate in a bath of oil. To simplify operation, the valve construction is of the rotating type, is made a part of the crank shaft, and works in a renewable bronze bushing. No gears or pinions are used.

The entire operating mechanism is readily accessible, the loosening of six cap screws removing the handle and exposing the interior for examination. The cylinders are interchangeable and can be replaced without renewing the main body of the casing. As shown in the accompanying illustration, the cylinders are provided with lugs to take care of the wear on exposed corners.

The grinder is rated to operate up to an 8-inch diameter emery wheel at a speed of 3,400 revolutions per minute. This machine is specially designed for grinding, buffing, polishing or cleaning castings.

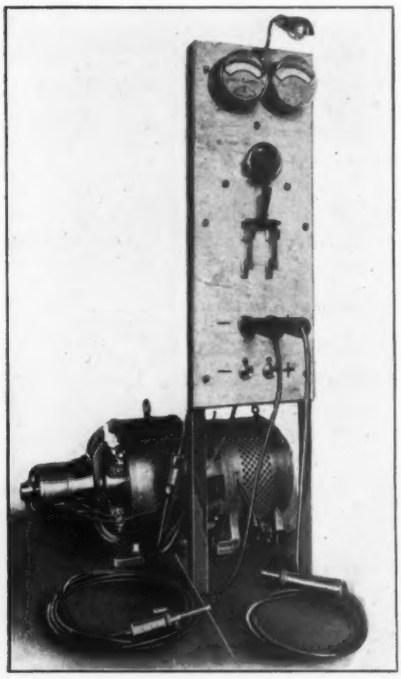
Ingersoll-Rand Close Quarter Drill

A new pneumatic drill for close quarter drilling, reaming, tapping, etc., is being offered to the foundry trade by the Ingersoll-Rand Co., 11 Broadway, New York. This tool, shown in the accompanying illustration, is particularly adapted for operations in confined positions where the regular type of four-piston reciprocating pneumatic drill built by this company cannot be used. The distance from the end of the casing to the center of the spindle is only $1\frac{5}{16}$ inches. The motor is of a novel, three-cylinder design and operates in a bath of oil. The valve is of the rotary type and is gear-driven from the pinion of a three-way crank shaft. This shaft is operated by three ratcheted levers which directly connect the pistons to the drill spindle. It is claimed that there is practically no strain on the crank shaft, as the power is transmitted direct from the pistons through the levers to the ratchet spindle. This spindle has a triple ratchet and another feature of the design of this drill is the engagement of one of the ratchets on the spindle at all times. It is claimed that this construction develops more power and a more constant pull on the spindle than



PNEUMATIC DRILL FOR CLOSE QUARTER DRILLING, REAMING, TAPPING, ETC.

otherwise would be the case. The casing is divided in such a way that the loosening of a few cap screws permits of easy access to all parts. The drill is fitted with a No. 4 Morse taper socket, is rated for drilling up to 3 inches and reaming and tapping up to 2 inches and operates at a speed of 150 revolutions per minute.



LINCOLN ARC WELDER COMPLETE WITH PANEL BOARD

The Lincoln Arc Welder

In the accompanying illustration is shown an arc welding outfit with panel board built by the Lincoln Electric Co., Cleveland. It is so constructed that it generates at all times the exact voltage required by the arc and at the same time gives a current which is practically constant. For this reason no resistance is necessary in the circuit to reduce the voltage and, therefore, no power is wasted. This feature is due to special windings in the generator.

The electric arc may be employed for welding practically all metals, although there are several practical difficulties such as always are encountered in welding work. The first difficulty involves the expansion and contraction of the metal resulting from heating a certain part or from adding new metal to any part. This may be overcome by different methods, the whole piece often being heated before the welding operation begins or it may be annealed after the welding operation is performed. Another difficulty in welding is due to the formation of oxides. Metals at a high temperature combine with oxygen and the oxides thus formed on the parts of the metal to be welded will prevent the metal from coming into intimate contact and a perfect weld cannot result. The welded surfaces, however, may be kept clean by floating the oxide on top of the molten metal.

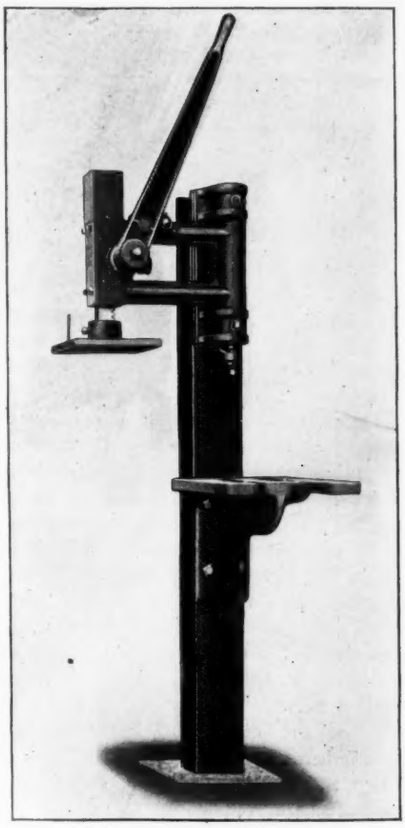
The simplest operation for the arc type of tool is the welding of steel castings. If it is desired to fill up a hole in a casting, a depression or other imperfection, the casting is connected to one end of the electric circuit that forms one of the electrodes. The operator handling the other electrode brings it in contact with the surface of the casting, then quickly withdraws it a short distance, causing the electric arc to form between the carbon and the casting. After heating the surfaces around the low spot or hole and melting the steel, he places a rod of steel in the flame of the arc and allows the metal to run into the low spot until it is filled. The machine also can be used to advantage for cutting-off risers, as well as welding cracks and sand spots. It is claimed also that the electric arc has been used successfully in welding malleable castings. This work usually is done after annealing, although castings can be welded in the hard. This machine also can be employed for welding rolled steel, wrought iron, forgings and for welding castings to other metals.

Direct current is employed and these welders will deliver their rated ampere output continuously with a temperature rise of not to exceed 40 degrees in any part except the commutator, on which the rise, it is claimed, will not exceed 55 degrees Cent. In plants having sufficient work to require more than one operator, a separate unit is installed for each man. Owing to the fact that no power is wasted in resistance, the actual power required to do the welding is small. For ordinary service, with the exception of large steel casting work and heavy cutting, it can be operated on any power line large enough to carry a 10-horsepower motor. This permits the installation of the plant at almost any point in the shop where there is a power line, or it may be made portable and connected where needed. Any number of plants also may be operated individually or in parallel. The operator, without the services of an electrician, can connect three 150-ampere plants in parallel to get 450 amperes for heavy carbon electric welding.

A grinding wheel should always have flanges from one-half to two-thirds the diameter of the wheel itself. These should be relieved in the center bearing about ½-inch at the outer edge. Never tighten the flanges directly against the wheel, but put in some soft or thick substance between flange and wheel.

Cooper Squeezer Molding Machine

A new molding machine of the squeezer type recently has been developed by the H. W. Cooper Saddlery Hardware Mfg. Co., Moline, Ill. It is provided with a movable head or arm which is supported on steel centers, so that it can easily be swung to right or left, enabling the machine to be used for bench molding as well as for squeezer work. The frame of the machine, which is formed from a steel H-beam 8 feet long and 5 inches square, is set upright in a concrete foundation 2½ feet deep. A steel bracket and bench are securely bolted to the frame. The bracket carries the swinging arm, as shown in the accompanying illustration. A shoe provided with a set screw and jam nut is attached to the lower end of the bracket to take up wear and to hold the swinging arm securely in place. Extra holes are drilled in the beam to adjust either bracket or bench.



POST TYPE SQUEEZER MOLDING MACHINE

Ordinary adjustments are made by loosening the screw in the pinion shaft and raising or lowering the ram, the lever being left in its usual position. The ram, which is 1½ inches square, is geared to a pinion shaft actuated by the lever. All working parts are covered, being located above the molder's bench for protection.

Personal

J. F. McNamara has been appointed general manager of the Bayonne Casting Co., Bayonne, N. J., to succeed W. E. Oakley, vice president and general manager, resigned.

Shellman Brown, Philadelphia, has been appointed superintendent of the Warren Foundry & Machine Co., Phillipsburg, N. J., succeeding Walter Ingham, who recently resigned after 23 years' service with the company.

Douglas J. Peake has been appointed foundry engineer and assistant to the general superintendent of the foundries of the Canada Iron Corporation, Montreal, Que. Mr. Peake formerly was affiliated with the United States Cast Iron Pipe & Foundry Co., Burlington, N. J.

F. N. Perkins, president of the Foundry & Machine Exhibition Co., with headquarters at the Lewis Institute, Chicago, and who was a representative of the Arcade Mfg. Co., molding machine manufacturers, Freeport, Ill., for many years, has resigned the latter connection to enable him to devote more attention to the affairs of the exhibition company.

Ralph T. Coe, manager of the Canadian Sirocco Co., Ltd., Windsor, Can., has resigned to enter the engineering service and sales field in New York. He has been appointed district manager for Warren, Webster & Co., Boston, and the American Blower Co., Detroit, with offices at 519 Insurance building, Rochester, N. Y., and 19 Live Stock Exchange building, Buffalo.

The title of dean of traveling salesmen has been conferred upon Arthur K. Ingraham, aged 78 years, who for 45 years has been in the employ of the Joseph Dixon Crucible Co., Jersey City, N. J. This honor was conferred upon Mr. Ingraham by his friend "Uncle George" Olney, who relinquished his claim to the title upon his retirement from active service with the Irving Pitt Mfg. Co., Brooklyn, N. Y.

George Davies has been appointed general agent of the Davies & Thomas Co., Catasauqua, Pa., with offices in the new Equitable building, 120 Broadway, New York. This company, in addition to carrying on its general foundry business, now is engaged on a large contract for castings for one of the subway tunnels now under construction in New York. In this line of work the Davies & Thomas Co. was among the pioneers in this country.

Oliver Phelps, widely known throughout the iron and steel industry and who for many years was engaged in the sale of pig iron in the Detroit and Michigan territory, has established an office at 1516 Ford building, Detroit, in the capacity of manufacturers' agent. Mr. Phelps will represent the Dayton Malleable Iron Co. and he is anxious to communicate with manufacturers having attractive accounts to offer with reference to representation in Detroit and throughout the state of Michigan.

Tribute to Memory of Thomas D. West

(*Continued from page 325.*)

tical experiences and even when he introduced the practice of others of his fellow craftsmen, he was sure that it was in accord with his own judgment, and due credit invariably was given.

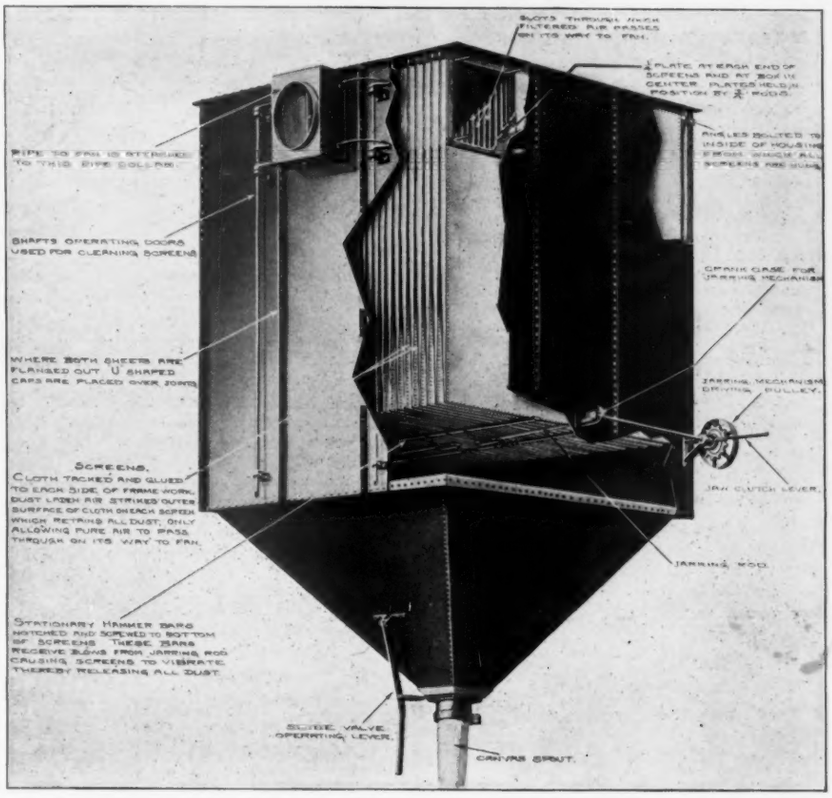
The two leading foundrymen of Cleveland in those days were John Stoney and Rufus Swift. Mr. Swift was foreman of the Cuyahoga Iron Works, now the Cleveland Ship Building Co., and he had the reputation of being one of the most successful and experienced molders in his day in the United States. About 1880 Mr. Swift retired and Mr. West was selected to fill his place, which was certainly a high honor, considering the reputation of his predecessor.

Mr. West has done more for progressive and scientific foundry practice than any foundryman of his time and as one of his oldest friends, the writer is desirous of recording this letter as an additional tribute to his memory.

P. L. SIMPSON,
National Engineering Co., Chicago.

Cloth Screen Dust Arrester

A cloth screen dust arrester, designed for collecting dust from tumbling mills, emery wheels, sand blast equipment, etc., is being manufactured by the Whiting Foundry Equipment Co., Harvey, Ill. As shown in the accompanying illustration, it consists of an outside case or housing made of heavy sheet steel, in which is located a series of cloth screens. These arrest all dust and permit the free passage of air. The screens are tacked and glued to each side of the frame, the dust-laden air striking the outer surface of the cloth on each screen, which retains all dust, permitting only the pure air to pass through on its way to the fan. The screens are vibrated by hammer bars notched and screwed to the bottom of each screen. This vibration causes the dust to fall from the canvas surfaces. As this arrester, it is claimed, will remove all of the dust from the air which passes through it, the air from the arrester may again be delivered into the shop.


PIPE TO FAN IS ATTACHED TO THIS PIPE COLLAR.
SHAFTS OPERATING DOORS USED FOR CLEANING SCREENS
WHERE BOTH SHEETS ARE FLANGED OUT U SHAPED CAPS ARE PLACED OVER JOINTS
SCREENS. CLOTH TACKED AND GLUED TO EACH SIDE OF FRAME WORK. DUST LADEN AIR STRIKES OUTER SURFACE OF CLOTH ON EACH SCREEN WHICH RETAINS ALL DUST, ONLY ALLOWING PURE AIR TO PASS THROUGH ON ITS WAY TO FAN.
STATIONARY HAMMER BARS NOTCHED AND SCREWED TO BOTTOM OF SCREENS. THESE BARS RECEIVE BLOWS FROM JARRING ROD CAUSING SCREENS TO VIBRATE, THEREBY RELEASING ALL DUST.
SLIDE VALVE OPERATING LEVER.
CANVAS SPOUT.
CRANK CASE FOR JARRING MECHANISM
JARRING MECHANISM DRIVING PULLEY.
JAW CLUTCH LEVER.
JARRING ROD.

CLOTH SCREEN DUST ARRESTER BUILT BY THE WHITING FOUNDRY EQUIPMENT CO.

The Brennan Steel Casting Co., 2284 Scranton road, Cleveland, is making some important improvements to its plant, including the erection of a new building, 50 x 150 feet. New equipment also will be purchased, including sprue-cutting machinery and jar-ramming molding machines.

WHAT THE FOUNDRIES ARE DOING

Activities of the Iron, Steel and Brass Shops

The Graf Stove & Range Co., Louisville, Ky., will equip a foundry.

The Saturn Machine Co., Wheeling, W. Va., will install and equip a brass foundry.

The Monarch Aluminum Ware Co., Cleveland, has increased its capital stock from $10,000 to $20,000.

The Swedish Steel Casting Co., Windsor, Ont., Can., will double its capacity by the installation of additional equipment.

The United States Malleable Iron Co., Toledo, O., has increased its capital stock from $150,000 to $250,000.

The Homestead Valve Mfg. Co., Homestead, Pa., has increased its capital stock from $50,000 to $75,000.

The capital stock of the Taylor & Boggis Foundry Co., Cleveland, has been increased from $150,000 to $200,000.

John F. Dornfeld has purchased and is operating the plant of the Dornfeld-Kunert Co., Watertown, Wis.

The Indiana Brass Co., Frankfort, Ind., has increased its capital stock from $10,000 to $25,000.

The Central Foundry Specialty Co., Detroit, has increased its capital stock from $25,000 to $50,000 and has changed its name to the Central Specialty Co.

The F. S. Newman Co., Ltd., Winnipeg, Man., Can., has been incorporated with a capital stock of $100,000 to operate an iron foundry and machine shop.

The Mt. Pleasant Iron Foundry, Inc., New Bedford, Mass., has been incorporated with $8,000 capital by William Sloane, William Wignall and Benjamin Allmond.

The Victor Specialty Co., Canton, O., has purchased the Carrollton Novelty Co., Carrollton, O., for $40,000 and will manufacture sheet metal and cast iron toys.

The Jackson Iron & Bronze Works, Jackson, Tenn., which contemplates establishing a foundry in connection with its ornamental iron plant, will increase its capital stock to $50,000.

The Phoebus Foundry Co., Phoebus, Va., whose foundry recently was sold to Mr. Thomas, of the Sayre Iron Works, will continue its business, having leased the plant from the new owner.

The Perkins Foundry Co., Amsterdam, N. Y., has been incorporated with $20,000 capital to engage in the manufacture of hardware, engines and boilers. The incorporators are W. E. and E. Walker and D. B. Perkins.

The Semi-Steel Foundry Co., New Portage, O., has been incorporated with a capital of $10,000 by Herman Peterson, Gustav A. Schwartz, A. S. Herdman, M. H. Behncke and E. P. Brown.

The Western Foundry & Metal Co., Ltd., the Canadian Equipment Co., Ltd., both of Calgary, Alta., Can., and the International Supply Co., Ltd., Medicine Hat, Alta., have consolidated and will operate under the name of the Canadian Western Foundry & Supply Co, Ltd., with head office at Calgary. The capital stock of the new company is $1,000,000.

The Continental Piston Ring Co., Memphis, Tenn., has been incorporated in West Virginia with a capital stock of $100,000 by B. H. Mason, Ft. Worth, Tex.; W. P. McCadden, C. R. Bryant, S. W. Partlock and J. E. McCadden, Memphis, Tenn.

E. F. Rogers, formerly affiliated with the C. W. Raymond Co., Dayton, O., has resigned to start a foundry in that city to be known as the Edgemont Foundry. A specialty will be made of piston rings and small engine cylinders.

The Wood-Ewing Iron Works, Portland, Ore., has been incorporated by R. B. Wood and L. H. Ewing, who formerly were affiliated with the John Wood Iron Works. The new concern has taken over the North Star Iron Works.

The Bay State Brass Rail Co., Boston, Mass., brass manufacturer, brass founder and finisher, has been incorporated for $10,000 by John F. Williams, George A. Macdonald, James P. Clare, George F. Spearin and Louis Wernicke.

The old Star foundry, Worcester, Mass., which has been idle about five years, has been started again by the Crompton & Knowles Loom Works and is giving employment to 40 molders with the prospect of the number being increased to 100 before the end of the summer.

New Construction

The Inman Foundry Co., Amsterdam, N. Y., is building a 2-story, 40 x 60-foot plant.

The Atlas Foundry Co., Detroit, Mich., will erect a foundry, 85 x 270 feet, to cost $25,000.

The Jahant Heating Co., Akron, O., is building a foundry at a cost of $30,000.

J. P. Raymond and Fred S. Raymond, of Syracuse, N. Y., contemplate building an iron foundry at Bemidji, Minn.

Lusk, Anglemeyer & Lockwood, Troy, O., will erect a 1-story, 56 x 80-foot foundry of reinforced concrete construction.

The Special Machinery & Foundry Co., Martinsville, Ind., is constructing two buildings, each 100 x 100 feet.

The American Car & Foundry Co., Inc., 165 Broadway, New York City, will erect additions to its plant at Milton, Pa.

The Acadia Gas Engine Co., Bridgewater, N. S., Can., will build an addition to its foundry at a cost of $10,000.

The L. W. Pond Machine & Foundry Co., Worcester, Mass., contemplates practically doubling the capacity of its plant.

The Ed. L. Smith Foundry Co., Amsterdam, N. Y., is building a plant, 1-story, 40 x 70 feet.

The Baltimore Tube Co, Baltimore, Md., will erect a 1-story, 37 x 62-foot foundry at a cost of $6,000.

Cortland Bros. and associates, of Marion, Ind., contemplate erecting a plant in Toledo, either on the Wheeling & Lake Erie or Terminal railroad, to be known as the Grey Iron Foundry. Approximately $35,000 will be expended for building, site and equipment.

The Wayne Brass Foundry Co., 4635 Butler street, Pittsburgh, will erect an addition to its plant.

The Auto Crank Shaft Co., Detroit, is erecting an addition to its foundry at a cost of $10,000.

The Iowa Malleable Iron Co., Fairchild, Ia., will erect a concrete and stone building, 1-story, 50 x 100 feet.

The American Car & Foundry Co., Wood street, Chicago, is building a 66 x 205-foot addition to its plant at a cost of $20,000.

Plans have been completed for a 1-story, 60 x 80-foot addition to the North End Foundry, West Allis, Wis.

Plans have been made for a 44 x 132-foot addition to the foundry of Pettibone, Mulliken & Co., Chicago.

The Columbia Machine Works & Malleable Iron Co., 69 Chestnut street, Brooklyn, N. Y., contemplates erecting additional buildings.

The Springfield Foundry Co., Indian Orchard, Mass., will rebuild its plant recently destroyed by fire.

The Bridgeport Piston Ring Co., Bridgeport, Conn., will erect a 2-story, 35 x 76-foot addition to its plant at a cost of $10,000.

The H. Root Foundry Co., 1749 Ballou street, Chicago, will build a 1-story addition to its plant at a cost of $2,000.

The Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich., contemplates building an addition, 75 x 175 feet, to its foundry.

The Chickasha Foundry & Machine Co., Chickasha, Okla., is building a foundry at a cost of approximately $20,000.

A contract has been awarded for the erection of a 1-story, 18 x 26-foot addition to the foundry of the Globe Malleable Iron & Steel Co., Syracuse, N. Y.

The Dominion Wheel & Foundry Co., 131 Eastern avenue, Toronto, Ont., will erect a 1-story frame and galvanized addition to its foundry at a cost of $5,000.

The Edenburg Foundry & Mfg. Co., Edenburg, Pa., recently incorporated, has over 100 acres of land under lease or option and will erect a plant for the manufacture of car wheels, brake shoes, grate bars and castings.

The Federal Radiator Co., New Castle, Pa., has acquired the property of the Penn Motor Co. and will build several additions to the plant. Foundry equipment will be installed in a new building.

A contract has been awarded for the erection of a four-story, 61 x 320-foot factory building and a 38 x 50-foot foundry for the Frantz-Premier Co., Cleveland. The cost will approximate $115,000.

Howard Cole & Co., new proprietors of the Ford & Donnelly foundry, Kokomo, Ind., will build a new shop for the manufacture of heavy castings, a new power plant and will make other improvements, to cost approximately $75,000. The old foundry will be remodeled and used for lighter castings.